THE FOUNDRY

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The Reclamation of Non-Ferrous Metals

Description of the Equipment and Practice of a Large Smelting and Refining Plant for the Recovery of Copper, Tin and Lead

NON-FERROUS metal reclamation from so-called waste, but in reality by-products, has attained a high state of development. The value of the material to be recovered undoubtedly led to the invention and subsequent perfection of the many processes now employed in refining and smelting plants, by which all but a very small percentage of the metal is returned for commercial use. Volatilization losses, notably of zinc, are still heavy, however, although these are being materially reduced in many shops by proper melting methods. In gray iron and steel works operations, the scrap return is unusually heavy, being roughly estimated at one-fourth of the new metal produced. A larger proportion of light ferrous metal scrap also is being used today, which in former years was not considered of any great value for melting purposes, by both foundrymen and steel works operators. Tin plate clippings, scrap cans and similar material heretofore were utilized only for conversion into sash weights. The introduction of chemical processes of detinning, however, has greatly increased the value of this

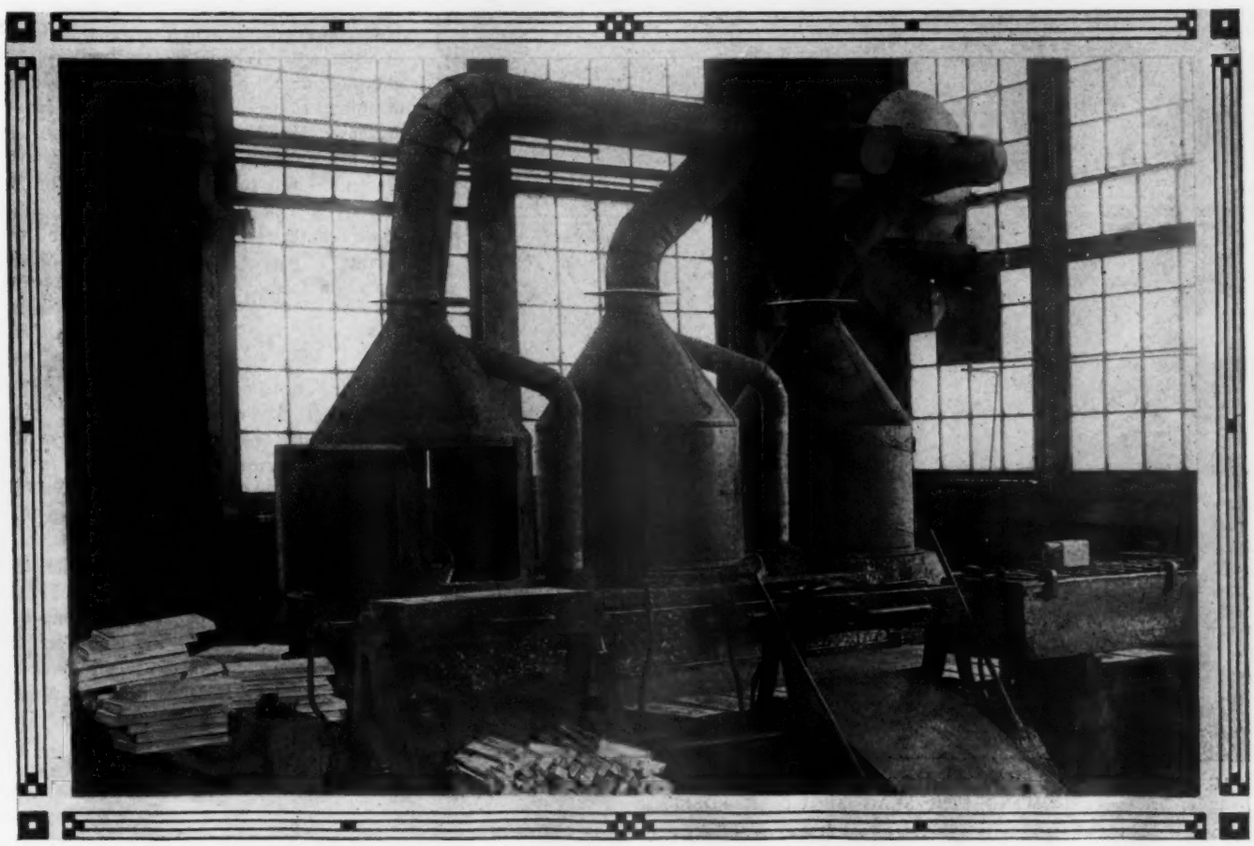


FIG. 1—BABBITT, SOLDER AND SCRAP ZINC FURNACES IN THE SMELTING AND REFINING PLANT OF THE WESTINGHOUSE ELECTRIC & MFG. CO.; THE CAPACITY OF THESE FURNACES IS 15,000 POUNDS DAILY

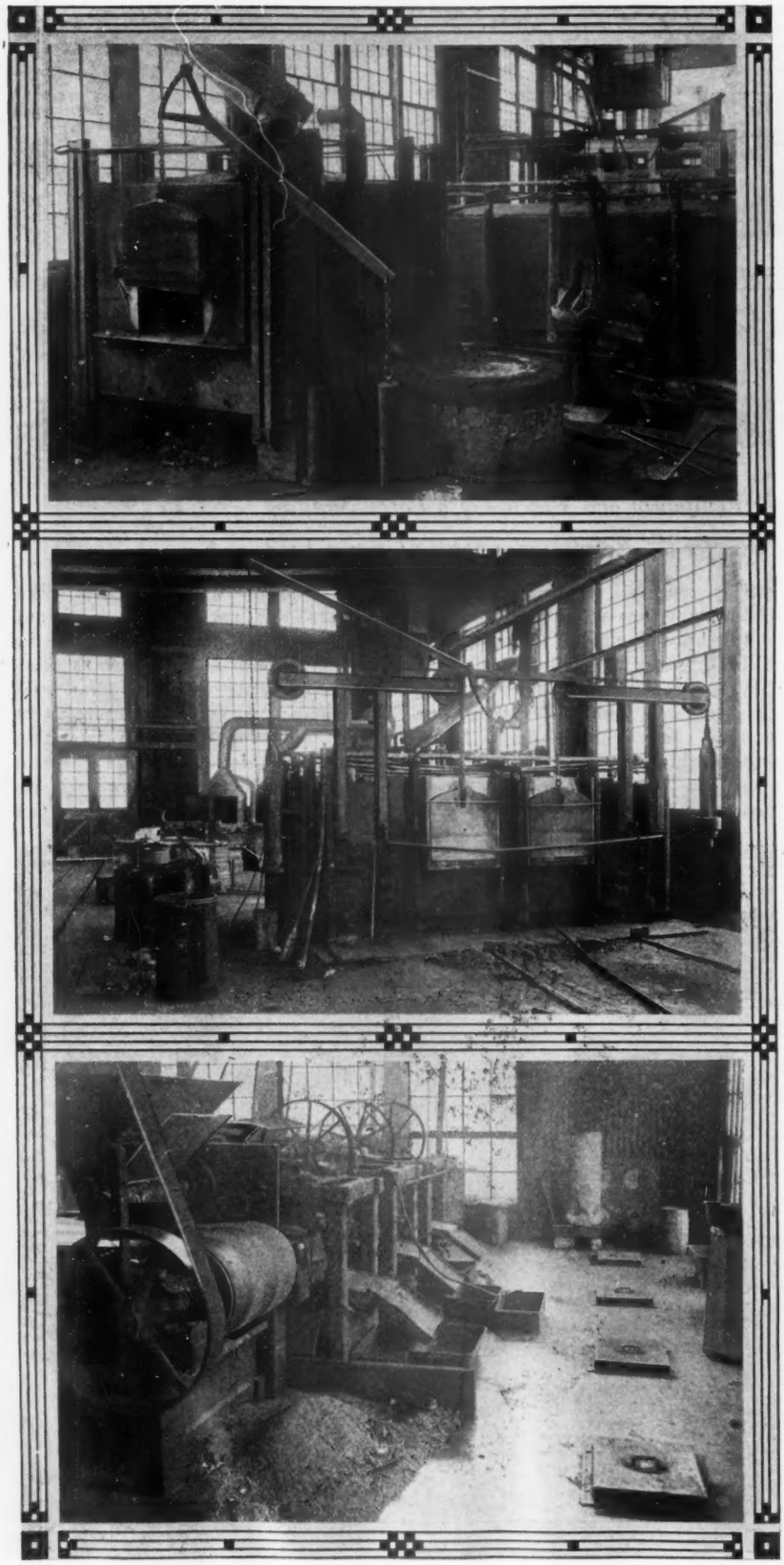


FIG. 2—SWEATING FURNACE, ALSO TAPPING SIDE OF REDUCING FURNACE SHOWING THE SLAG SPOUT IN POSITION

FIG. 3—CHARGING SIDE OF THE NATURAL GAS-FIRED, REGENERATIVE REDUCING FURNACE

FIG. 4—THE FOUR MAGNETIC SEPARATORS LOCATED ON A PLATFORM OVER THE BINS FOR THE CLEANED BORINGS AND TURNINGS

scrap. Nearly all of the tin is recovered and the steel, which is practically a by-product of the detinning plants, is baled and sold at fairly high prices to the steel works. A crude method of recovering the solder from tin cans, at one time practiced, consisted of heating the cans to a temperature which would melt the solder. The recovery, however, was so small that no serious effort ever was made to develop a more economical process.

In gray iron foundries, the cinder mill recovers a large portion of the metal from the cupola drop and the water mill is employed for a similar purpose in brass foundries, the furnace ashes and slag being operated upon in the latter plants. To reduce excessive oxidation losses when remelting iron borings and turnings, these are charged into the cupola enclosed in boxes or pipes and several briquetting processes have been devised which reduce the melting losses of these fine particles to the minimum. In brass foundries, this material can be handled to better advantage than in gray iron shops, although compression briquetting, by which the metal chips are formed into a compact mass, now is being introduced.

Practically all of the plants engaged in the production of alloys in ingot form for the brass foundry trade are equipped to reclaim non-ferrous metals from sweepings, grindings, skimmings, drosses, etc. When this material is not obtained direct from the foundries and machine shops, it is purchased from dealers. However, the brass foundries that have carried metal recovery beyond the water mill stage are limited in number, as a considerable amount of this waste material must be available to operate a plant for this purpose on a profitable basis.

Large Westinghouse Plant

In view of their tremendous daily accumulation of non-ferrous scrap, the Westinghouse companies, several years ago, decided to reclaim the metal from this material at one of their works and this resulted in the erection of a large smelting and refining plant, which is operated as one of the departments of the Westinghouse Electric & Mfg. Co.'s brass foundry at East Pittsburgh, Pa. All of the non-ferrous metal scrap produced by the allied Westinghouse interests in the Pittsburgh district is refined at this plant, which has an average output of 600,000 pounds per month consisting of ingot copper, brass alloys, white and babbitt metals. The copper production is considerably in excess of the requirements of the Westinghouse Electric & Mfg. Co.'s brass foundry and the surplus produced is sold

to other Westinghouse interests or is disposed of in the open market. The only virgin metals purchased consist of tin, zinc and lead.

While a large proportion of the material to be reclaimed is in the form of sweepings, skimmings, drosses, turnings, borings, etc., considerable high grade scrap, consisting of copper wire, copper sheet clippings, etc., is available. The equipment of the plant is unsually complete and furnaces are provided for all of the various recovery operations with the exception of smelting the tailings, which are sold. Fig. 1, from left to right, shows the babbitt, solder and scrap zinc furnaces respectively, while Fig. 2 illustrates the sweating furnace in the foreground and the tapping side of the reducing furnace in the background. Two views of the copper refining furnaces are shown in Figs. 5 and 6, and the Schwartz open-flame, oil-fired furnace is illustrated in Fig. 10.

Since this plant has been in operation, the Westinghouse Electric & Mfg. Co. has not been compelled to buy copper in ingot form. The output of the copper refining furnace averages 250,000 pounds monthly, which is considerably in excess of the needs of the company's foundry. In addition to the ingot copper, solder, babbitt and white metals produced by this plant, 26 different alloys are mixed, which are delivered to the foundry in ingot form.

Copper Refining Furnace

The copper refining furnace, shown in Figs. 5 and 6, is of the reverberatory type, has a capacity of 30,000 pounds and one heat can be made in 24 hours. It is natural gas-fired, the burners being located at one end, as shown at the left, Fig. 5. The furnace is charged through two openings in one side, which are covered with counterweighted doors and the bottom is inclined toward the tapping end, Fig. 6. The copper is ladled out of the furnace and is cast into water-cooled ingot molds, shown at the left, Fig. 7. The curved stack is not a feature of this type of furnace, but this novel construction had to be adopted to avoid interference with the operation of the overhead traveling crane. All forms of copper scrap are charged into the furnace, including bare and insulated wire, copper sheet clippings and other materials high in copper content. The zinc contained in the scrap volatilizes and the iron oxidizes, no trace of the latter being found in the refined copper. Silica sand is thrown onto the metal bath and the lead therein combines with the sand and forms silicate of lead. The tin is carried into the slag, as well as a small percentage

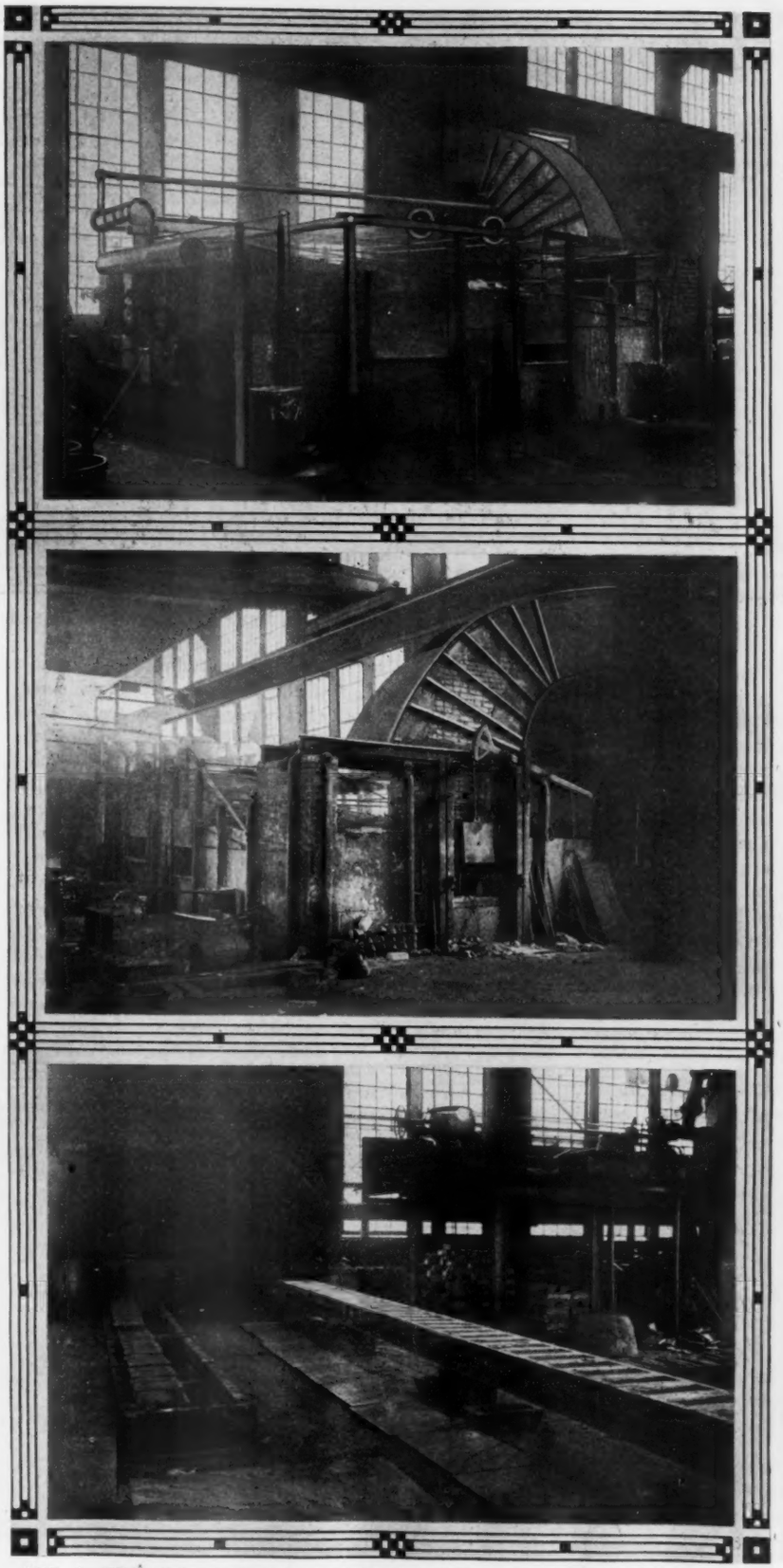


FIG. 5—CHARGING SIDE OF COPPER REFINING FURNACE AND FIRING END, SHOWING THE GAS BURNERS

FIG. 6—TAPPING END OF COPPER REFINING FURNACE. THE METAL IS LADLED OUT BY HAND

FIG. 7—THE MOLDS FOR THE INGOT COPPER ARE SHOWN AT THE LEFT AND THE BRASS MOLDS ARE AT THE RIGHT

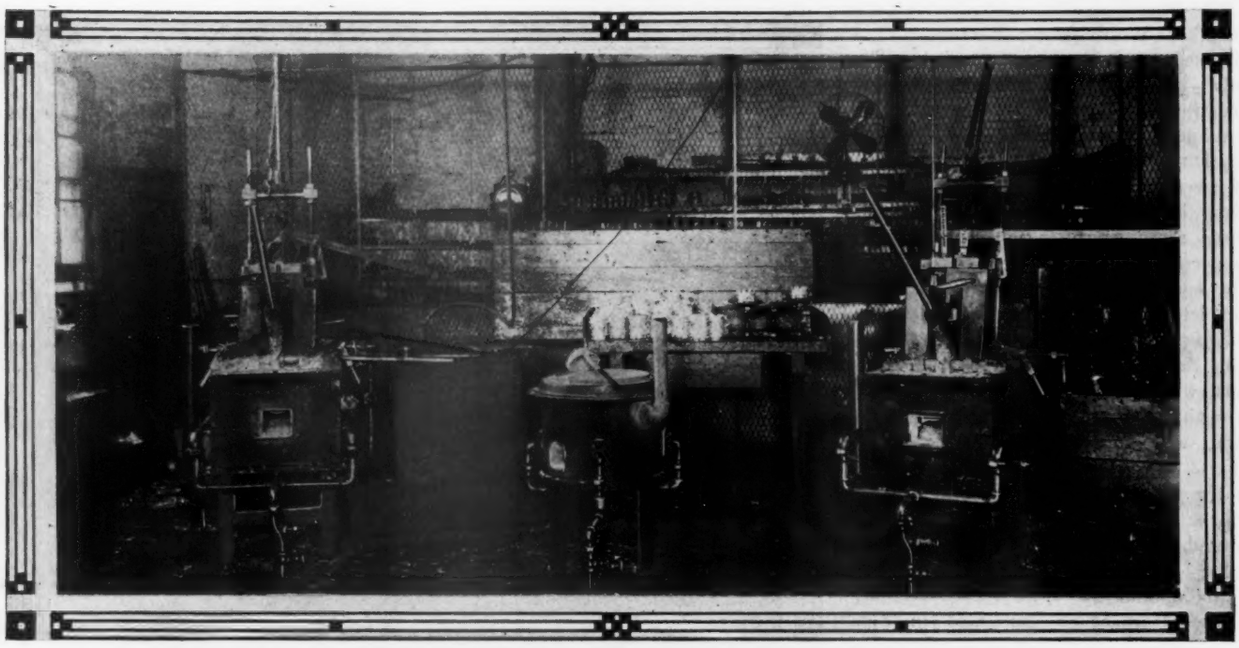


FIG. 8—TWO OF THE DIE-CASTING MACHINES WITH METAL MELTING POT IN THE CENTER

of lead and some copper. All of the slag is analyzed and is again remelted to recover the contained metals. The refined copper produced is of unusual purity, averaging 99.5 per cent, and the electrical conductivity is high, varying from 97.4 to 99.1 per cent.

The reducing furnace, Fig. 3, the tapping side of which is shown at the right, Fig. 2, is of the regenerative open-hearth type and is fired with natural gas. Emery grindings, sweepings, metal-bearing slag, etc., are charged into the furnace and the metal yield, on the average, is high. Floor sweepings average approximately 16 per cent of metal, including lead, copper and tin, and the recovery from emery grindings averages 80 per cent. After the slag has been tapped out of the furnace and cooled, it is crushed and the pieces containing traces of metal are again charged in small amounts. As illustrated in Fig. 3, the furnace has burners on either side and these are changed and the air is reversed at intervals of 20 minutes. The tapping side of this furnace is shown at the right, Fig. 2, the slag spout suspended by a chain being in position to divert the slag into a cast iron pot. The metal is tapped into a ladle for casting into ingots and during the tapping operation, the slag spout is swung aside. The sweating furnace, Fig. 2, is employed for the recovery of the softer white metals by the sweating process. The metal is run into a reservoir at the side, from which it is dipped and cast into ingots.

The babbitt, solder and scrap zinc furnaces, Fig. 1, are of the standard type provided with hoods to carry off the fumes. The zinc furnace is at the right, with the exhaust fan located on a platform directly above. Great care is exercised in making the babbitt metal mixtures and these are tested for hard-

FIG. 9—THE METAL STORAGE ROOM

ness by a Brinell machine. The hardness numerals of the tin babbitts vary from 32 to 35, and the lead babbitts, which are softer, range from 20 to 25. Subsequent tests of the babbitt metals are made after remelting and before the bearings are cast, to insure the maintenance of the original properties. Frequently this metal is injured by remelting and this test is a check against casting into bearings babbitt metal so damaged. In the foreground, Fig. 1, are shown two stands of water-cooled molds for babbitt metals and solder. Each stand contains two sets of molds and after casting, the molds are rolled over, discharging the bars. The bottom molds, which had an opportunity to cool during the previous casting operation, are turned upward and the metal is cast into these. In the meantime, the lower set is cooling.

The Schwartz oil-fired furnace, Fig. 10, is employed for melting turnings and borings and has a capacity of 18,000 pounds per heat. The different alloys used in the brass foundry are melted in this furnace and the accuracy with which a specified mixture can be obtained is remarkable. The alloys never vary from the formulae more than 1 per cent, notwithstanding the use of scrap which aggregates 75 per cent of almost every heat. For example, an alloy was specified, containing 80 per cent of copper, 10 per cent of lead, 10 per cent of zinc and 0.25 per cent of phosphorus. Turnings amounting to 75 per cent of the charge were used in this mixture, yet the resulting analysis of the alloy was within less than 1 per cent of the specified formula. In this instance, the alloy analyzed as follows: Copper, 79.64 per cent; lead, 9.39 per cent; tin, 10.80 per cent, and phosphorus, 0.17 per cent.

Sampling the Turnings

As far as possible, yellow and red brass turnings are kept separate in the various machine departments, where this scrap is produced, thereby greatly facilitating the subsequent mixing and melting operations. The material first is delivered to the magnetic separators, Fig. 4, for the removal of the steel and iron, and after cleaning, is shoveled into bins underneath the magnetic separator platform through openings which are covered in this view. Each bin has a capacity of 50,000 pounds, and this amount of scrap is considered as a unit from which the sample is taken for an analysis representative of the entire lot. The turnings and borings are shoveled over to insure a thorough mixture of the material and after this has been accomplished, the original unit is halved, mixed and halved again. This is continued until a 100-pound sample is obtained, which is melted in a crucible. The contents of the pot are cast into an ingot, which is analyzed in the chemical laboratory. This analysis represents the contents of the 50,000-pound unit of the bin and with this as a basis, any alloy can be made by suitable additions of scrap or virgin metals. As a result of the care exercised in mixing the turnings and in obtaining the sample, the analysis represents exactly the contents of the 50,000-pound unit and to this is attributed the production of alloys within a limit of less than 1 per cent of the specified formula.

The metal melted in the Schwartz furnace is cast into ingots, the molds being shown at the right, Fig. 7. Oil is used for fuel and the melting operation is carried on under high pressure. The blast pressure is 22 ounces and that of the oil, 40 pounds. As a result, volatilization is greatly reduced, this being aided by only a 4-inch opening in the furnace. The zinc losses average less than 1 per cent and turnings covered with oil and dirt can be melted with losses varying from 4 to 6.8 per cent, while the actual metal losses rarely exceed 2.8 per cent. Frequently the total metal losses are as low as 1.4 per cent. Notwithstanding the high pressure maintained in the furnace by the 4-inch opening and the high blast and oil pressures, the lining has a life of about

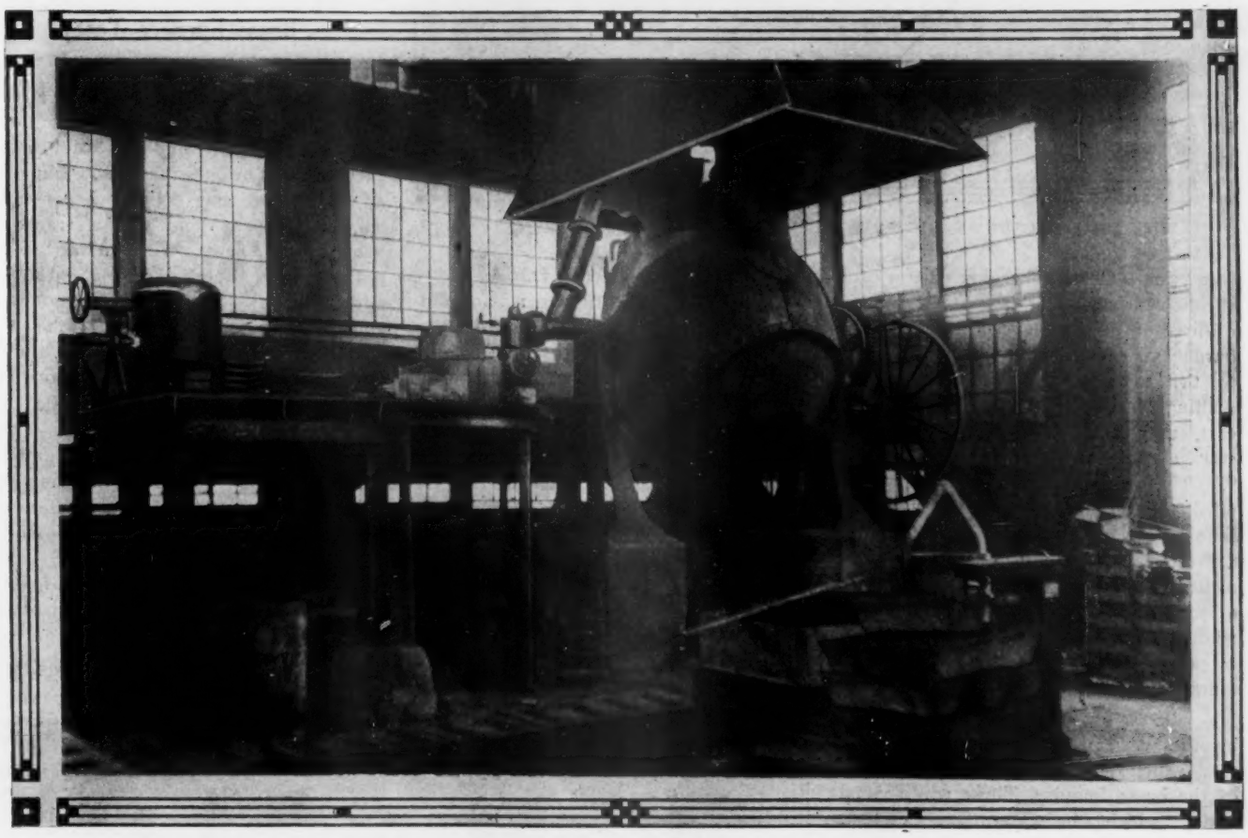


FIG. 10—THE SCHWARTZ, OPEN-FLAME MELTING FURNACE; CAPACITY, 18,000 POUNDS PER DAY

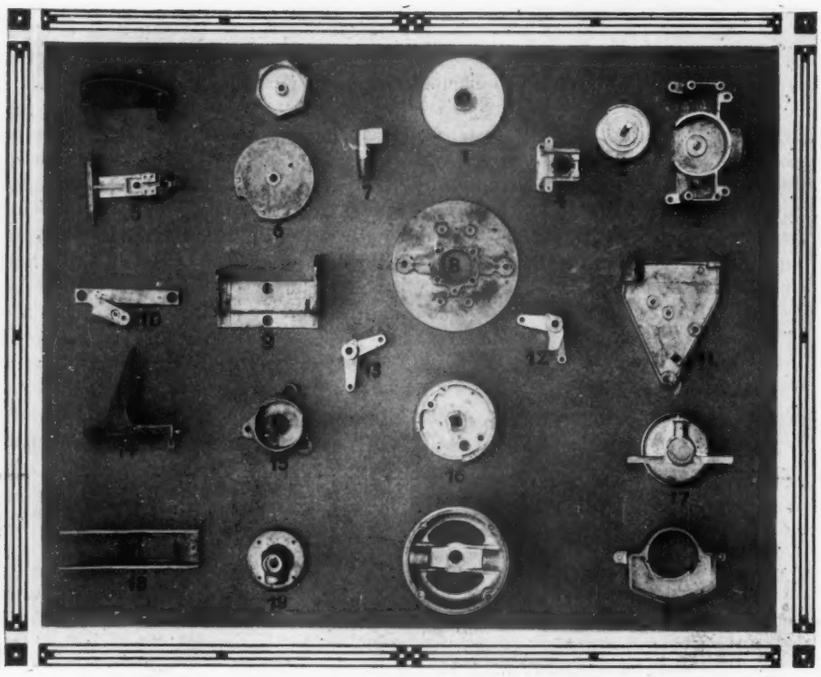


FIG. 11—A GROUP OF DIE-CAST PARTS FOR METERS, MOTORS, ETC.

five years. On the charging platform of the Schwartz furnace is a Steele-Harvey oil-fired crucible furnace for melting hardeners, copper, etc., which are added to the various mixtures in the large melting vessel. After the ingots are cast, they are delivered to the metal storage room of the brass foundry, Fig. 9. The various alloys are separately piled and marked to facilitate their delivery to the furnaces of the foundry for the various mixtures that are to be melted. Approximately 1,000,000 pounds of metal are carried in stock, which, in addition to the alloys, includes ingot copper produced in the smelting and refining plant, lead, tin, etc.

A die-casting plant also is operated by the Westinghouse Electric & Mfg. Co., which is one of the departments of the brass foundry. These white metal parts, which include many difficult shapes, are finished, ready for assembling, and do not require subsequent machining. Two of the five die-casting machines in this department are shown in Fig. 8, with the melting pot in the center, from which molten metal is ladled into the metal pots of the two machines. These are operated by five men and depending upon the size and form of the piece being made, the output varies from one to six castings a minute. To facilitate their operation, the original machines have been practically rebuilt by the Westinghouse company.

A few samples of a wide variety of die-cast parts are illustrated in Figs. 11 and 12. A gear for a prepayment wattmeter is shown at *1*, Fig. 11, and *2* is a coin selector for this machine; *3* is a prepayment wattmeter frame, and *4* is a frame piece for supporting an automobile wattmeter; *5* is a brush arm for a circuit breaker, *6* is a spring chamber for a prepayment wattmeter and *7* shows an overflow oil plug for a motor, and it will be noted that one end of this casting is threaded. The remaining die-cast sections in Fig. 11 follow: A mounting plate for recording meter is shown at *8*; *9*, drum support for portable graphic meter; *10*, movement support for meter; *11*, side frame for circuit breaker; *12* and *13*, toggle links for circuit breaker; *14*, armature lever for circuit breaker; *15*, cap for automobile generator; *16*, face plate for automobile generator; *17*, dash pot for inverse time element relay; *18*, carbon arm for circuit breaker; *19*, bearing bracket for fan motor; *20*, bracket for a 1/12-horsepower motor, and *21*, contact case for automobile generator.

The various die-cast pieces in Fig. 12 follow: Motor bearing, *1*; *2*, gear case for oscillating fan motor; *3*, base for relay; *4*, switch frame for testing wattmeter; *5* and *6*, end bracket for automobile generator; *7*, flanged support for automobile ignition coil; *8*, main support for switchboard induction meter, and *9*, frame for a small motor.

Brass Furnace Test

The Monarch Engineering & Mfg. Co., Baltimore, has received a report of a test of one of its combustion chamber, oil-fired crucible tilting furnaces. The mixture used consisted of 90 per cent copper, 7 per cent tin, 3 per cent zinc and a trace of lead. Five heats were made in a period of 6 hours and 46 minutes, and allowing 37 minutes for pouring and recharging the furnace, the actual melting time was 6 hours and 9 minutes. Four of the heats consisted of 711 pounds of metal, while the fifth contained 400 pounds of metal. The first four heats were made respectively in 1 hour, 41 minutes; 1 hour, 18 minutes; 1 hour, 10 minutes, and 1 hour, 12 minutes, while the fifth heat was made in 48 minutes. There were no casting losses from these heats and the oil consumption per 100 pounds of metal for the five heats was as follows: 2,78, 1.78, 1.57, 1.57 and 2.01 gallons.

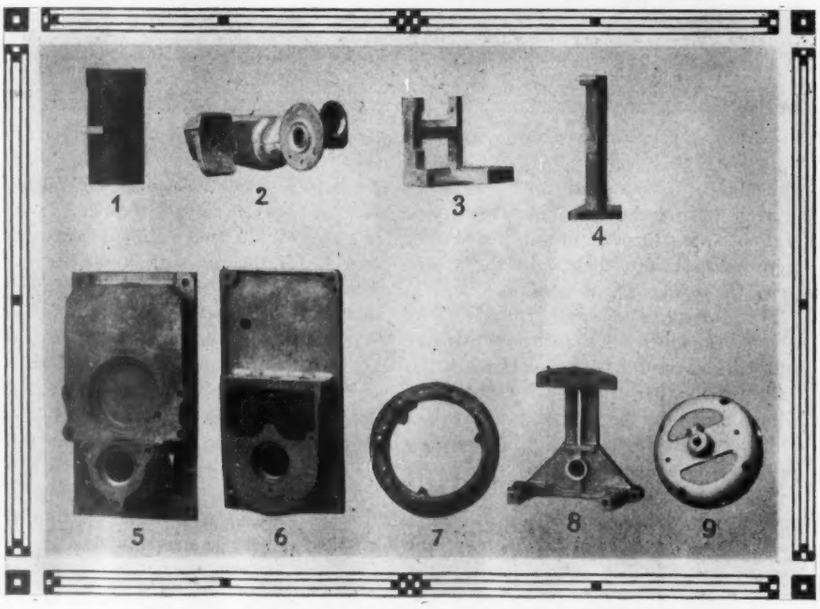


FIG. 12—ANOTHER GROUP OF DIE-CAST PARTS

Melting Basic Open-Hearth Steel for Castings*

Methods of Preparing the Tap Hole and Spout and Working the Bath Are Discussed, With Pertinent Suggestions Regarding the Influence of Slag

By H F Miller Jr.

FOR some years the prejudice against basic open - hearth steel for casting has been gradually decreasing. Yet many consumers and engineers still cling to acid steel for castings, because of their alleged greater freedom from blow-holes and sponginess.

Acid steel has been used for this purpose much longer than basic steel; and the melters in acid practice had it well in hand when basic steel was first tried. Then the necessity of learning a new set of laws for the production of satisfactory basic open-hearth steel for castings became evident.

The first of these laws, in my opinion, has to do with the furnace construction. The heat should be melted down as speedily as possible so as to prevent excessive oxidation.

Size of the Furnace

The hearth of the furnace, however, is a decisive factor in the production of solid castings. The manufacturer should know the size of the heats he intends to make constantly, and should have his furnace built for that size of heat. The hearth should differ in dimensions from that of a furnace making ingot steel. That is, the bath should be deeper and should have less surface area. A shallow bath permits the slag to come out soon after the steel commences to flow, and thus prevents the additions from going into the steel, or from becoming uniformly distributed in case they have been put in hurriedly.

Under this head comes the very poor practice of making small heats in hearths of a much larger capacity. If into a 25 or 30-ton furnace only 12 or 15 tons of metal is charged per heat, the proportion of heats that will be wild or show signs of wildness at some time during the pouring, will be comparatively large; whereas, when the hearth is charged to capacity, a heat showing signs of wildness will be a rare occurrence.

The nature and action of the slag is an important factor in the manufacture of quiet steel. Slags are usually roughly classified by the melter according to physical appearance, as follows:

The *dry*, heavy slag occurring when there is very little silica present. This is a dangerous slag if not carefully worked. The burning of many furnaces is due to reflection of the heat to the roof by this slag. Another danger is that the melter, deceived by the physical appearance of the slag, may add an excessive amount of fluorspar. This results in a badly-cut ladle and burning off of the stopper rod. These disasters can be prevented by a gradual addition of spar until a wet slag is created, after which the heat may be worked down as usual. With natural gas the heat will foam for some time.

A *wet* but *lumpy* slag is good to work with. The lumps of limestone should be broken with a rod, so that a rocky bottom may be avoided. In some cases, an unbroken lump will choke the tap hole, so that the flow of the slag being stopped, the steel is left uncovered until the tap hole can be freed. A large amount of heat is lost from the steel thereby. A lumpy slag can be avoided by charging small size limestone.

A third slag is the very watery variety, usually occurring when heats melt at high temperature, by reason of the presence of an excessive amount of silica. This slag should have burned dolomite or raw limestone added until a thick slag is made. When the slag is too thin, it will mix with the steel in tapping and a wild steel will be the product. The ladle and stopper rod will be badly scorified, and usually some tons of steel will go into the pit by reason of a burned-off stopper rod.

Ideal Slag

The ideal slag is heavy and wet with no large lumps. This slag makes an easy heat to work and gives a steel low in phosphorus and sulphur. It requires but a small amount of fluorspar to put this slag in shape for the ladle. A heavy slag of this nature will not mix with the steel, and will generally stay in the furnace until the steel is nearly all in the ladle. It also has the good quality of cutting neither the stopper rod nor the ladle brick. The only objection is that it causes a dirty bottom, and unless a washout is made after each heat, the bottom will rise to the sill plate level after a few heats. This result shows very poor practice. No time is ultimately gained by charging without the usual washout.

If a washout, continuing from 20 to 30 minutes, is made after each heat, the furnace will work fast for a much longer time. Moreover, the holes that occur in a *high* bottom will be largely avoided, if the bottom is kept low and clean.

The Tap Hole and Spout

The tap hole should be kept large and low. The quicker steel gets into the ladle, the more heat is retained. The shorter a spout, the better, for the same reason. Moreover, a large tap hole will not clog up easily if rabbling has to be done and few *hard* taps will occur. In shutting the tap hole magnesite is best, because it does not burn together, making a *hard* tap, nor does magnesite boil out, as may happen when a tap hole is closed with green dolomite. Burned dolomite, however, may be safely used, the only drawback being an occasional hard tap, due to the burning together of the material.

These facts are probably known to most melters; but unless vigilance is constant, one factor is apt to be overlooked. The bottom may be low, and the tap hole satisfactory, but the spout, if not smooth at the end, may cause the stream to spray over the ladle, thus losing much heat and causing a skull.

The addition of alloys may be made in the bath or in the ladle. By putting them into the bath, much heat is saved. This is a valuable method where a furnace is working cold or a heat has melted *low* and there is difficulty in getting it hot. The advantage is that the additions are made while the flame is still on the bath, and the loss of the heat in the bath caused by dissolving the alloys can be regained. The objections are that a large amount of each alloy must be added, since, in this way, from 15 to 30 per cent goes into the slag, and the silicon, reacting, will throw back the phosphorus into the steel.

Putting the additions into the steel

*From a paper presented at the New York meeting of the American Institute of Mining Engineers.

as it goes into the ladle is, in my opinion, the better method. A uniform distribution of alloys is attained shoveling the alloys in gradually.

If the alloys are added in the ladle, the steel will be helped greatly by first raising them to red heat, especially in winter.

The Working of the Steel

After the heat has melted down and the limestone has boiled up, the charge will be benefited by allowing it to *soak* from 15 to 30 minutes. This will allow any contained slag and a large volume of the gases to rise. Ore may then be fed if necessary; or, if the heat has come *ready*, it remains only to get the steel hot.

Sometimes heats will melt low, and bath begins to pick up heat *the slag turns to water.* If the charge is tapped with the slag in this condition, and it takes more than 30 minutes to pour, the steel remaining in the ladle will be lost, as the stopper rod will be burnt off and the ladle badly cut. On the other hand, if the slag is watery and the attempt is made to thicken it, much heat will be lost, and time consumed before it will be ready to tap. This suggests the rule "Add fluorspar sparingly" thereby expensive mistakes will be avoided.

If the slag comes too quickly and all the additions have to be made to the first part of the heat, an even distribution can be obtained by rabbling the heat. If some of the additions are lost in the slag, or if not enough have been put in, the heat showing signs of *wildness,* a simple remedy is to take a number of sticks of aluminum, bend a tapping rod around them, thrust them to the bottom of the ladle, stir the bath with them and rabble it afterward if necessary. There is hardly a heat that cannot be made absolutely quiet by this means. But it is a curative treatment, and a prevention is always better.

The time consumed in pouring is a factor in determining the size of the heat. Good practice demands that a heat of steel should be poured in less than 60 minutes; the faster the better. To take longer than that, results in a reaction between the steel and the slag, which causes: (1) A loss of silicon and a gain in phosphorus and sulphur in the steel; (2) the exhibition of *wildness* in the steel; (3) the skulling of the ladle; (4) misrun castings; (5) high ladle cost due to the cutting of the brick by the slag and (6) overheating the stopper rod, the bending of which causes the loss of the remaining steel.

Use of Fluorspar

The use of fluorspar seems also to make the steel less responsive to the quieting action of silicon, since the fluorine seems to be absorbed by the steel. I have noticed, when pouring a test, that after much spar has been used, the steel gives off a smoky gas of the same appearance as when fluorspar is added to the bath. If this is true, the action of fluorspar cannot be beneficial to steel when addel in large quantities.

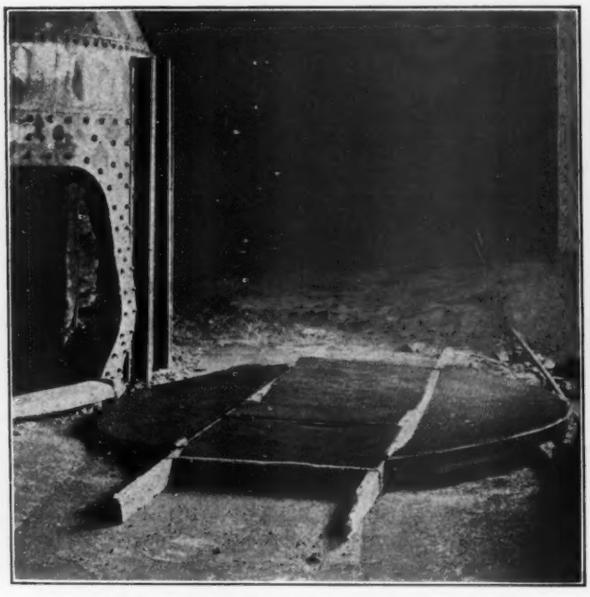


FIG. 1—SCREEN FOR PROTECTING EMPLOYES MAKING CUPOLA REPAIRS

FIG. 2—THE SCREEN WEDGED IN POSITION IN THE CUPOLA

if one is hampered with small ladles, or has no heavy castings to pour, it is best to get the heat ready by using manganese. This will not add much metal to the bath, and it is a good substitute for pig iron.

With large ladles, I would recommend working the heats with both pig iron and manganese. Very little, if any, ferro-silicon should be used instead of manganese, since the silicon mixes with the slag and cuts the stopper rod off while the heat is being poured. Hot metal is preferable to cold additions, as the bath is not then chilled by the addition.

The great danger in working *stickers* is in the treatment of the slag, which often looks thick and heavy by reason of a cold bath. The mistake is made constantly of adding too much fluorspar. The result is that when the

Cupola Accident Prevention

When chipping-out or relining cupolas, workmen frequently are injured by falling bricks or chunks of clay, which spawl off the lining. Workmen occasionally are seriously injured in this manner by being struck with bricks which fall out of the lining above the charging door while they are working near the furnace bottom. To prevent such accidents, several large foundries are using a screen in their cupolas when repairs are being made. As shown in Fig. 1, this screen is made in three sections, consisting of a central, rectangular portion and two wings. The screen in position in the cupola is illustrated in Fig. 2. The wings are hinged and can be folded over to permit of inserting the screen through the charging door.

DATA FOR THE GRAY IRON FOUNDRYMAN

CHEMICAL COMPOSITION OF GRAY IRON CASTINGS FOR VARIOUS PURPOSES

Type of Casting.	Silicon, Per Cent.	Sulphur, Per Cent.	Phosphorus, Per Cent.	Manganese, Per Cent.	Combined Carbon, Per Cent.	Total Carbon, Per Cent.
Electrical	2 to 3	UNDER 0.08	0.50 to 0.80	0.30 to 0.40	0.20 to 0.30	LOW
Eccentric straps	1.75 to 2	UNDER 0.09	0.40 to 0.60	0.60 to 0.80		
Embossing heads	1.25 to 1.50	UNDER 0.09	0.30 to 0.50	0.70 to 1		
Engine	1 to 2	UNDER 0.10	0.30 to 0.60	0.60 to 1		
Engine frames	1.25 to 2	UNDER 0.10	0.30 to 0.50	0.60 to 1		
Fan and blower castings	2 to 2.50	UNDER 0.08	0.60 to 0.80	0.40 to 0.60		
Farm implements	2 to 2.50	UNDER 0.08	0.50 to 0.80	0.50 to 0.80		
Ferrocyanide pots	3 to 4	UNDER 0.08	0.40 to 0.80	0.40 to 0.80		
Fire pots	2 to 2.50	UNDER 0.08	UNDER 0.50	0.60 to 1		
Flywheels	1.50 to 2.25	UNDER 0.08	0.40 to 0.60	0.50 to 0.70		
Friction clutches	1.75 to 2	0.08 to 0.10	UNDER 0.30	0.50 to 0.70		LOW
Furnace	2 to 2.5	UNDER 0.07	UNDER 0.30	0.60 to 1		LOW
Gas engine cylinders.	1 to 1.75	UNDER 0.08	0.20 to 0.40	0.70 to 0.90		3 to 3.3
Gears, heavy	1 to 1.5	0.08 to 0.10	0.30 to 0.50	0.80 to 1		LOW
Gears, medium	1.50 to 2	UNDER 0.09	0.40 to 0.60	0.70 to 0.90		
Gears, small	2 to 2.50	UNDER 0.08	0.50 to 0.70	0.60 to 0.80		
Grate bars	2 to 2.50	UNDER 0.06	UNDER 0.20	0.60 to 0.80	UNDER 0.30	LOW
Grinding burrs	0.60 to 0.90	0.10 to 0.12	0.20 to 0.40	0.40 to 0.60		
Grinding machinery, chilled castings for	0.50 to 0.75	0.10 to 0.12	0.20 to 0.40	1.50 to 2		
Gun carriages	1 to 1.25	UNDER 0.06	0.20 to 0.30	0.80 to 1		
Gun iron	1 to 1.25	UNDER 0.06	0.20 to 0.30	0.80 to 1	0.80 to 1	LOW
Hangers for shafting	1.50 to 2	UNDER 0.09	0.40 to 0.60	0.60 to 0.80		
Hardening pots	0.60 to 1	UNDER 0.06	UNDER 0.20	0.40 to 0.60		
Hardware, light	2.25 to 2.75	UNDER 0.08	0.60 to 0.90	0.40 to 0.60		
Heat-resistant iron	1.25 to 2.50	UNDER 0.06	UNDER 0.20	0.60 to 1	UNDER 0.30	LOW
Hollow ware	2.25 to 2.75	UNDER 0.08	0.60 to 0.90	0.40 to 0.60		
Housings for rolling mills	1 to 1.25	UNDER 0.10	UNDER 0.30	0.80 to 1		
Hydraulic cylinders, heavy	0.80 to 1.20	0.10 to 0.12	0.20 to 0.40	0.80 to 1		LOW
Hydraulic cylinders, medium	1.20 to 1.60	0.09 to 0.11	0.30 to 0.50	0.70 to 0.90		LOW
Ingot molds and stools	1.25 to 1.50	UNDER 0.06	UNDER 0.20	0.60 to 1		
Locomotive castings, heavy	1.25 to 1.50	UNDER 0.10	0.30 to 0.50	0.70 to 0.90		
Locomotive castings, light	1.50 to 2	UNDER 0.09	0.40 to 0.60	0.60 to 0.80		
Locomotive cylinders.	1 to 1.50	0.08 to 0.10	0.30 to 0.50	0.80 to 1		
Locks and hinges	2.50 to 2.75	UNDER 0.08	0.70 to 1	0.40 to 0.60		
Machinery castings, heavy	1 to 1.50	UNDER 0.10	0.30 to 0.50	0.70 to 0.90		LOW
Machinery castings, medium	1.50 to 2	UNDER 0.09	0.40 to 0.60	0.60 to 0.80		
Machinery castings, light	2 to 2.50	UNDER 0.08	0.50 to 0.70	0.50 to 0.70		
Machine tool	1.75 to 2.25	UNDER 0.09	0.50 to 0.70	0.50 to 0.70		
Mine car wheels	0.75 to 1.25	UNDER 0.10	0.30 to 0.50	0.40 to 0.60	0.70 to 1	
Motor frames, bases and spiders, large	2 to 2.50	UNDER 0.08	0.50 to 0.80	0.30 to 0.40	0.20 to 0.30	LOW
Motor frames, bases and spiders, small	2.50 to 3	UNDER 0.08	0.50 to 0.80	0.30 to 0.40	0.20 to 0.30	LOW
Molding machines	1.50 to 2	UNDER 0.09	0.40 to 0.60	0.60 to 0.80		
Mowers	2 to 2.50	UNDER 0.09	0.60 to 0.80	0.50 to 0.80		

DATA FOR THE GRAY IRON FOUNDRYMAN

CHEMICAL COMPOSITION OF GRAY IRON CASTINGS FOR VARIOUS PURPOSES

Type of Casting.	Silicon, Per Cent.	Sulphur, Per Cent.	Phosphorus, Per Cent.	Manganese, Per Cent.	Combined Carbon, Per Cent.	Total Carbon, Per Cent.
Novelty work	2.50 to 3	UNDER 0.08	0.80 to 1	0.40 to 0.60		
Nitre pots	1 to 1.50	UNDER 0.06	UNDER 0.20	1 to 1.50		LOW
Ornamental	2.25 to 2.75	UNDER 0.09	0.70 to 1	0.40 to 0.60		
Permanent molds	2 to 2.25	UNDER 0.07	0.20 to 0.40	0.60 to 0.90		
Permanent mold castings	1.50 to 3	UNDER 0.06	0.30 to 0.80	UNDER 0.40		
Piano plates	2 to 2.25	UNDER 0.08	0.40 to 0.60	0.60 to 0.80		
Pillow blocks	1.50 to 1.75	UNDER 0.10	0.40 to 0.60	0.60 to 0.80		
Pipe	1.50 to 2	UNDER 0.10	0.50 to 0.60	0.60 to 0.80		
Pipe fittings	1.75 to 2.50	UNDER 0.08	0.50 to 0.80	0.60 to 0.80		
Pipe fittings for superheated steam lines	1.50 to 1.75	UNDER 0.08	0.20 to 0.40	0.70 to 0.90		LOW
Piston rings	1.50 to 2	0.10 to 0.12	0.30 to 0.50	0.40 to 0.60		LOW
Plow points, chilled	0.75 to 1.25	UNDER 0.09	0.20 to 0.30	0.80 to 1		
Plugs for piercing billets	1 to 1.25	UNDER 0.08	0.20 to 0.30	0.40 to 0.60		
Printing press	1.75 to 2.25	UNDER 0.09	0.50 to 0.70	0.50 to 0.70		
Propeller wheels	1 to 1.75	UNDER 0.10	0.20 ot 0.40	0.60 to 1		
Pulleys, large	1.75 to 2.25	UNDER 0.09	0.50 to 0.70	0.60 to 0.80		
Pulleys, small	2.25 to 2.75	UNDER 0.08	0.60 to 0.90	0.50 to 0.70		
Pumps, hand	2 to 2.25	UNDER 0.08	0.60 to 0.80	0.50 to 0.70		
Radiators	2 to 2.25	UNDER 0.08	0.60 to 0.80	0.50 to 0.70	0.50 to 0.70	
Railroad castings	1.50 to 2.25	UNDER 0.10	0.40 to 0.60	0.60 to 0.80		
Retorts	1.75 to 2	UNDER 0.06	UNDER 0.20	0.60 to 1		LOW
Rolls, chilled	0.60 to 0.80	0.06 to 0.08	0.20 to 0.40	1 to 1.20		3 to 3.25
Scales, castings for	2 to 2.50	UNDER 0.08	0.60 to 1	0.50 to 0.70		
Slag car bowls	1.50 to 1.75	UNDER 0.07	UNDER 0.20	0.60 to 1		LOW
Smoke stacks, locomotive	1.75 to 2	UNDER 0.10	0.30 to 0.60	0.60 to 0.80		
Soil pipe and fittings	1.75 to 2.25	UNDER 0.10	0.50 to 0.80	0.50 to 0.80		
Steam cylinders, heavy	1 to 1.25	UNDER 0.10	0.20 to 0.40	0.80 to 1		LOW
Steam cylinders, medium	1.25 to 1.75	UNDER 0.09	0.30 to 0.50	0.70 to 0.90		
Stove plates	2.25 to 2.75	UNDER 0.08	0.60 to 0.90	0.50 to 0.80		
Toys	2.50 to 3	UNDER 0.08	0.80 to 1	0.40 to 0.60		
Typewriter castings	2.50 to 2.75	UNDER 0.08	0.60 to 0.80	0.50 to 0.60		
Valves, large	1.25 to 1.75	UNDER 0.08	0.20 to 0.40	0.80 to 1		
Valves, small	1.75 to 2.25	UNDER 0.08	0.40 to 0.60	0.50 to 0.70		
Water heaters	2 to 2.25	UNDER 0.08	0.30 to 0.50	0.50 to 0.70		
Weaving machinery	2 to 2.25	UNDER 0.09	0.50 to 0.80	0.50 to 070		
Wheels, large	1.50 to 2	UNDER 0.09	0.30 to 0.50	0.60 to 0.80		
Wheels, small	1.75 to 2.25	UNDER 0.08	0.40 to 0.60	0.50 to 0.70		
Wheel centers	1.25 to 1.50	UNDER 0.10	0.30 to 0.50	0.70 to 0.90		
White iron castings	0.50 to 1	0.08 to 0.10	0.30 to 0.60	0.40 to 0.60		
Woodworking machinery	1.75 to 2.25	UNDER 0.09	0.50 to 0.70	0.50 to 0.70		

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form

THE FOUNDRY DATA SHEET, APRIL, 1913

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Making Foundry Tools by Short-Cut Methods

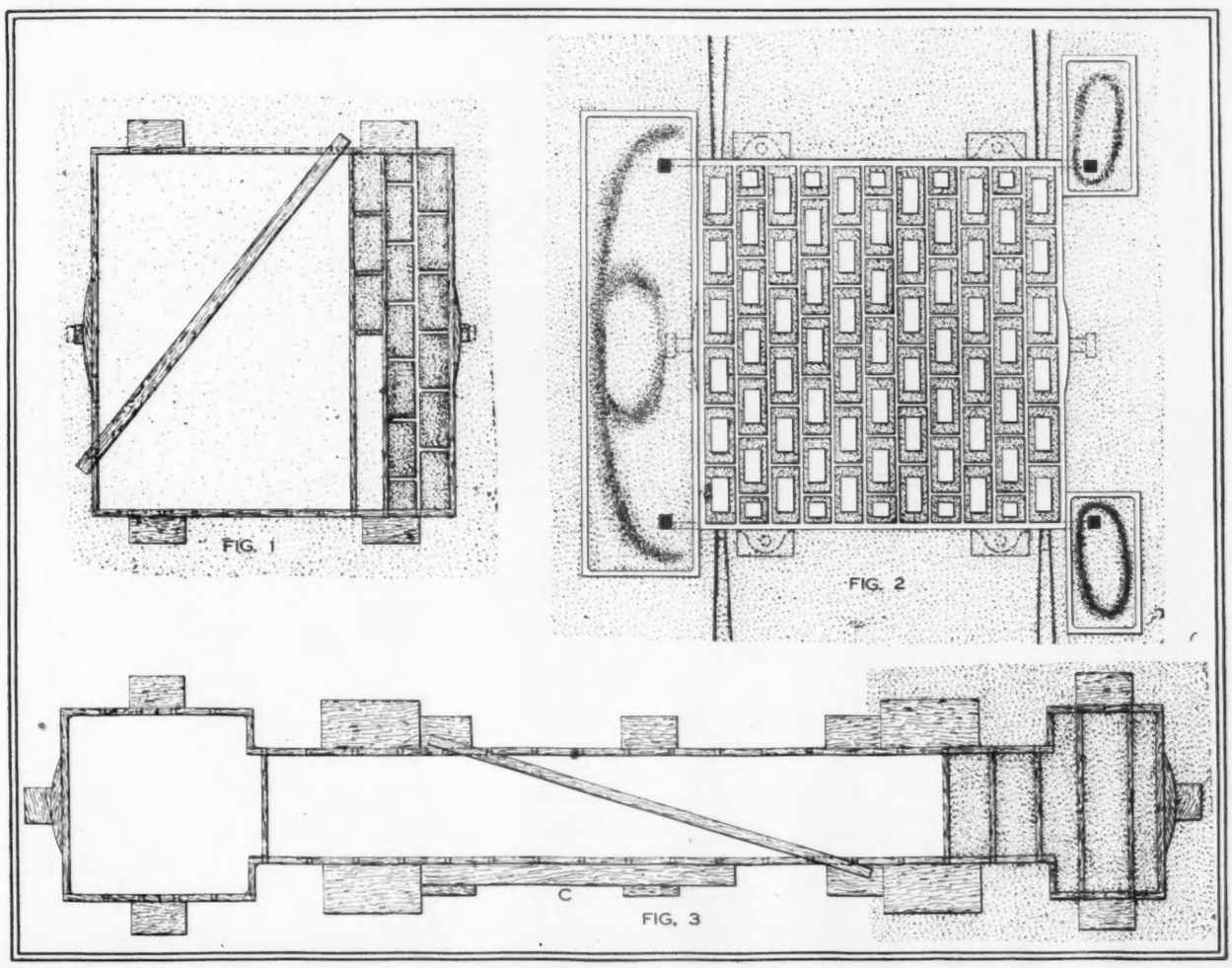
Simple Methods of Molding and Casting Iron Flasks Are Described, With Data on Patternmaking for This Work

By Joseph Horner

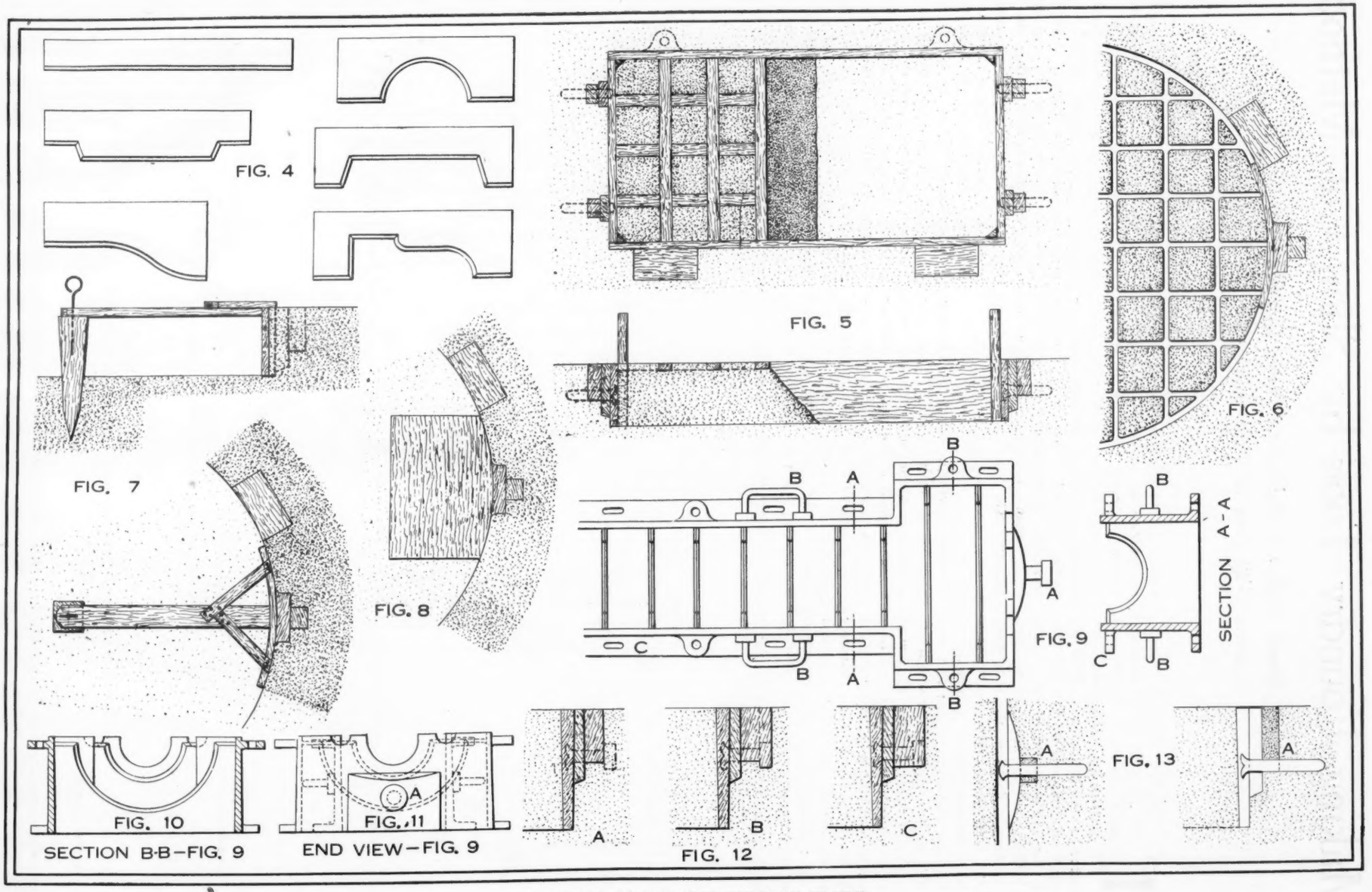
IN EVERY shop devoted to the manufacture of castings, many so-called tools and considerable equipment are produced in the foundry to meet the varying requirements of the different jobs that are presented from day to day. This work includes the molding and casting of flasks of all kinds, back plates, core rings and core plates, grids, drawback plates, lifters or S hooks, and numerous plates and aids to molding and coremaking which are required for other general or special purposes. Complete patterns are only occasionally employed. Some of the work is of a temporary character made for one job and later is broken up. But a large part of this equipment is for permanent use, kept in stock, and employed either for standard service or for that of a miscellaneous general jobbing character. The skill of the molder is often shown in making the numerous articles required either with no help from the patternmaker, or with the least possible expense for patterns or pattern parts.

Flasks

Flasks comprise much the largest part of foundry tools. They are made from complete patterns only when of small dimensions, of peculiar and irregular outlines, and when several castings from one pattern are required. A pattern frame is necessary for the flask sides, but when the bars or stays are all alike and numerous, lumber is saved by making three pattern bars and ramming them in succession, setting them in by measurement only, or by lines marked across the top edges of the flask sides, as shown in Fig. 1. After the three bars have been set, two sand spaces are rammed and then the inner bar is moved forward and another space is rammed. This operation is continued until all of the bars have been rammed. When, as in the case of all but the smallest flasks, cross bars are included, three or four patterns of these are set in and rammed between the main bars, and at the same time as the latter. The outside of the main frame is rammed simultaneously with the inner portions, so that bulging may not occur either in-



MOLDS FOR FOUNDRY FLASKS



METHODS OF MOLDING FOUNDRY FLASKS

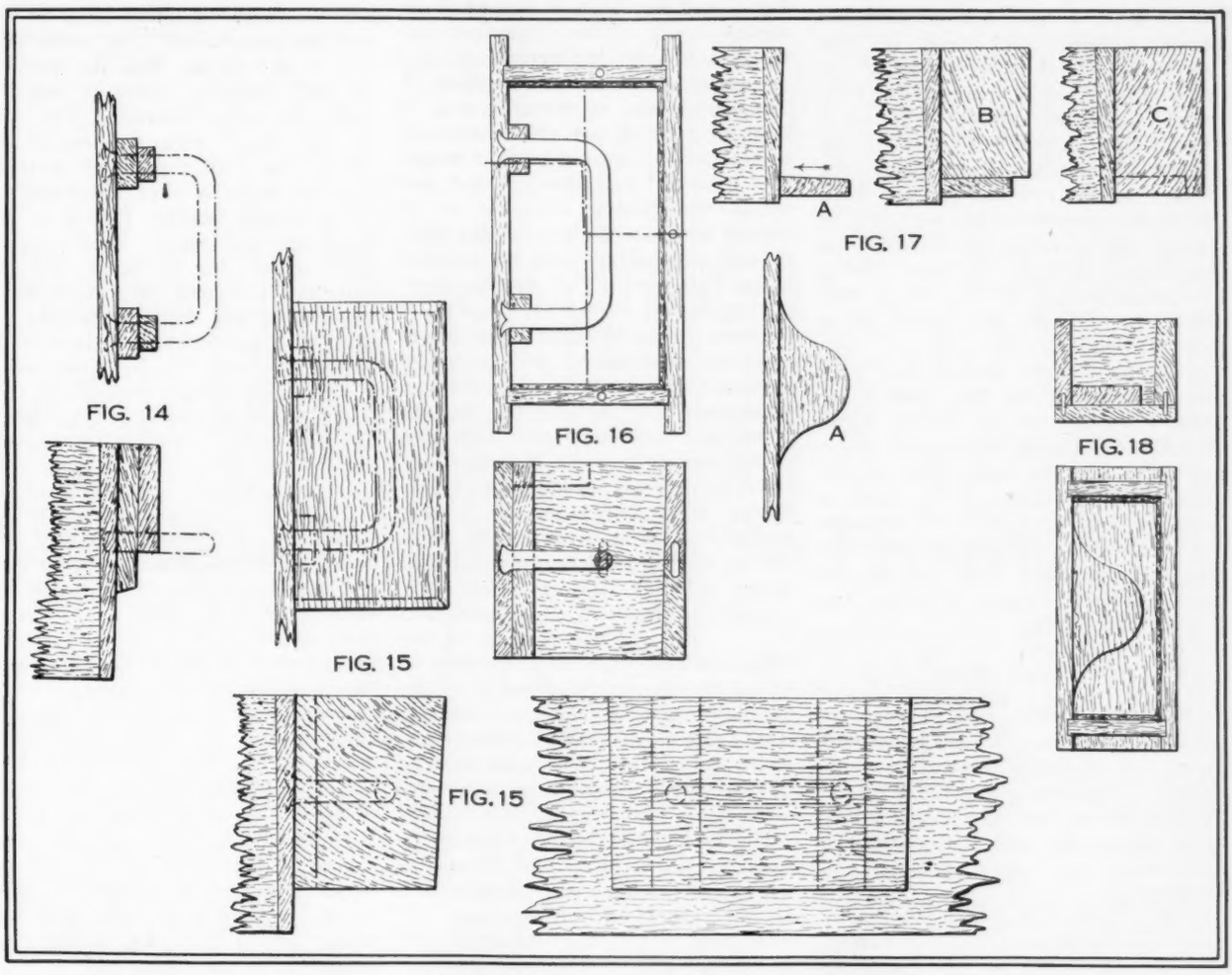
wardly or outwardly. To prevent the frame from becoming rammed out of square, a diagonal strip is screwed or tacked on, and remains there until the frame is so far rammed that it will not become distorted on the removal of the strip.

Unless a flask is very shallow, the wall of sand between the bars must be secured with a few vertical rods driven in below their bottom edges and coming up nearly to the level of the top edges. The sand being rammed around these will be sustained, not only against risk of being broken by the withdrawal of the pattern bars, but also of being washed away by the flow of metal. If the flask is cast in open sand, to which reference will be made later, each wall of sand is weighted to prevent the possibility of lifting by the metal. Such a mold is shown in Fig. 2 with pouring basins, and flow-off channels.

The foregoing method is suitable when the bars are all alike, that is, either all straight, or all shaped alike as in the typical examples shown in Fig. 4. But when they differ in section, as for example in the flask for a tapered column with enlarged base and capital, or one for a casting with sundry brackets around which the bars have to be shaped, and work of a similar nature, it is better to make the flask pattern complete even though a large amount of lumber is required. An alternative is to have three or four bars, and cut and reshape them as the section molding proceeds. This, however, is not satisfactory, and it does not meet the requirements of the numerous flasks which can only be made accurately by fitting them over the actual patterns which have to be molded.

The same outer pattern frame is used for cope, drag and cheek, the bar arrangements being altered, and the depth also when necessary. The flat bars of the drag or bottom are almost always measured in position and rammed in detail, being all alike, and shallow, Fig. 5. Only when there are vertical bars in the bottom, as in column and pipe flasks, is it sometimes desirable to put them all in the pattern from which to mold the drag flask. The cheek, being usually free of bars, has strips cast around its inner edges which are laid in, and rammed within the sides. In Fig. 5, angles are shown screwed in the corners of the box and extending several inches above the top edge. These serve as aids in lifting the pattern from the sand. Fig. 3 shows a stage in the making of a pipe or column flask to some details of which reference will be made later. It shows a skeleton frame with a diagonal strip to prevent cross-working. The positions of the bars are marked on the top edges, and some removable bars are being rammed at the right. These bars are worked along until the ramming is completed.

With reference to flasks of other shapes than plain rectangular, the framing for these have to be made complete, and a pattern bar has to be inserted at one or more intervals to enable the frames to maintain their shape, otherwise the top and bottom parts would not match when cast. One of these is shown at the left



ATTACHING HANDLES TO FOUNDRY FLASKS

of Fig. 13. It is usually better to make such flasks complete with bars.

Circular flasks may have the outside swept up, and the bars set in by measurement. A segment on a radius rod is suitable, as shown in Fig. 7. With this the complete ring can be rammed outside, and afterward the loose bars can be located and rammed at the same time as the inside of the rim. But the sweep piece has to be laid in the mold at the ends of the bars to sustain the sand. The same sweep is used, with the radius bar removed, Fig. 6. Another method is to strike a level bed of sand and to lay a sweep block on it, set only by a circle marked on the sand, Fig. 8, and to ram an annular wall of sand against the block. Then lay a swept piece against the ends of the bars and ram the latter, while the inner curve of the swept piece forms the interior of the ring, Fig. 6. As the bar patterns are shifted from the center towards the sides (being shortened by the sawing off as they leave the center) the sweep pieces also are shifted.

In shops where pulleys are cast, the patterns of the rims (which are separate from the arms) are sometimes used to mold the rims of circular flasks. As the pulley rims are too thin, they are thickened by laying a number of strips against them within or without, the latter preferably, filling the interspaces with sand sleeked level with the strips, and ramming against that surface.

Polygonal Flasks

Polygonal flasks, usually octagonal or decagonal, are often made in preference to circular ones. Then the framing is constructed to the shape required, united with one or two fixed bars across the central portion, and the other bars are measured and rammed.

The outside fittings of flasks usually have to be located on the pattern frame. But the pin lugs are often measured in, because as a rule they are covered with a core, and one combined lug pattern and core print may do duty for the four or six lugs required around a flask. They are set by center lines marked on the lug and print, and on the flask sides, and top edges. Straight handles, swivels and looped handles, are all made of wrought iron and cast in, being set by print impressions. The thickening of metal around these is made by pieces attached to the pattern. Strips for guiding stakes, flanges for back plates, and anything else required, are molded from pieces attached to the pattern frame. Most of these fittings are shown in Figs. 9, 10 and 11, which illustrate portions of the flask, the skeleton or pattern frame of which is shown in Fig. 3. Fig. 9 is a plan view at the joint taken next to one end, and Figs. 10 and 11 are cross-sections at *A* and *B*.

Trunnions

When flasks have to be rolled over, they are either hung by trunnions, by which the boxes are balanced, or else chains are looped round the handles similar to those shown in Fig. 5, and the flasks so supported are turned over. The trunnions are dropped into the impressions of drop or pocket prints, and are stopped off. They are made of wrought iron or steel, because if cast they would not be trustworthy, since the whole weight of a flask and its contained sand, and maybe the casting also, has to be carried by the trunnions. Being cast-in, additional metal must be provided in the flask ends. This may be parallel, or better, curved, as in Fig. 9. In order to avoid making new pieces for every new pattern flask, a few of these are kept in stock. They vary in dimensions and proportions to suit trunnions of different diameters, which may range from ¾ inch in the shank to 2 or 2½ inches, with proportionate differences in length, to suit flasks of different depths. The latter will be shallow or deep, or of medium depth, and they may have plain bars, straight or nearly so, or bars cut, Fig. 4. The vertical position of the trunnions will have to be located at about the center of gravity of the flask so that the flask, when rammed, will swing freely. Hence the trunnions will seldom be located midway in the depth, but usually at some distance above the center.

The pocket or drop print put on to receive the trunnion may be of the same size at the semi-circular end as the shank, *A*, or it may include both shank and collar, *B*, or the collar only, *C*. In the case of *B*, no sand has to be dug away. In *C*, where the print and collar are coincident a little sand is filled in under the shank. In *B*, the fit is right for both portions and the necessary stopping-off is left for the molder. The thicknessing piece and the pocket print are fastened together. They may be fastened also to the sides or ends of the flask pattern for which they are to be used, or they may be measured in place, set by a center line only. Thickness pieces and prints for trunnions are shown in Figs. 1, 3, 6, 7 and 8.

Handles are of two kinds, straight and looped. The first are located on the ends of flasks, Fig. 5, while looped handles are used on the sides of long flasks, Fig. 9, both for turning them over, whether being in trunnions or not, and for lowering them into pits for vertical casting. They are usually of wrought iron or steel, being cast in, thickness pieces being employed. Frequently, on small flasks, the straight handles are of cast iron, but the great objection to their use is the practical certainty of their being knocked off accidentally.

Straight handles are dropped into the impressions of pocket prints having the same curvature, Fig. 13, *A*, and are stopped-off. The prints need not be any thicker than the diameter of their handles, which is sufficient guide for their insertion. The sand is dug away with the trowel far enough to permit of their insertion and this space is filled afterward.

The looped handles, Fig. 9, *B*, are made in two ways. Two separate drop prints can be fitted, Fig. 14, sufficient to guide the location of the handle, and the sand is then cut away with the trowel to permit of the insertion of the handle, after which it and the print impressions are stopped-off. This is the usual method.

Handle in Core

A more workmanlike method and better for standardized purposes is to put the handle in a core. This entails dividing the box to permit of the insertion of the splayed and jagged ends by which the security of the handles in the casting is enhanced. The block print is shown in Fig. 15, and the box corresponding therewith, in Fig. 16. The box is jointed and doweled along the central plane of the handle, and the handle is inserted after one-half has been rammed. The other half is then put on and the core is completed. Four prints for cores of this kind are shown in Fig. 3. If, as in Fig. 9, a flange, *C*, is cast along the top edge of the flask to receive a back plate, the standard flask will have the addition of a flange piece, as indicated by the dotted lines in Fig. 16.

Securing the trunnions and handles is insured by spreading out the ends which enter into the metal and by jagging the shank. To prevent the formation of blow-holes, the trunnion or handle is made red hot to burn the rust off shortly before it is inserted in the mold. Sometimes also it is brushed over with tar or oiled, both being done to prevent rust from forming.

The lugs which receive the pins and their holes by which flask sections are

registered are usually made in cores. It is not necessary that they should be so made, but it is always more convenient. When a box is made complete, that is, with all its bars put in the pattern, the lugs cannot be drawn-in horizontally because the walls of sand left between the bars are in the way. But when the interior is rammed in detail with movable pattern bars the lugs can be drawn-in before the bars are rammed, Fig. 17, *A*, and the space can be covered temporarily with a strip of wood of the same thickness as the metal. In any case, the sand is liable to become damaged, and the core is, therefore, always preferable.

The core print can be carried up to the top edge of the flask, as shown in Fig. 17, *B*, and the pattern lug can be nailed on the bottom end, leaving a plain, square core to be inserted over it as indicated in Figs. 1, 2, 3 and 5, or the lug can be included in the flask, Fig. 17, *C*. Either method involves making a new core box for every flask which differs in depth, and as dimensions of lugs vary, this would entail making a large number of different core boxes. This is overcome by making a few standard, rather shallow flasks, each for a lug of different proportions, and using these for molds of different depths. A flask of this type is shown in Fig. 18, and includes the lug. The prints used are of the same size as the core, both in length and width, but they extend to the top of the flask. Often, however, no prints are used. In that case the centers of the lugs are marked on the pattern, and the molder digs away the sand in that vicinity, and lays the core in by a center line scratched on the core, setting it vertically by measurement, and level by measurement from the top edge, or by a spirit level laid on the core. Then sand is thrown in above it and rammed and strickled level with the top edge of the flask. In Figs. 1 and 3, prints for lugs are shown. In Fig. 5, prints are shown on one side and loose lugs on the side opposite.

Flanges

Flanges, Fig. 9, *C*, are cast on the top outside edges of flasks for fastening back plates for vertical casting. They need not be put on complete in the pattern when flasks are of large dimensions. A short length of flange may be rammed in detail, moving it along until the mold is completed, Fig. 3, *C*; but as holes have to be cast for bolting the back plates, Fig. 3, these must later be measured in the mold. When bolt hole cores are measured-in, prints are not used, but the cores are laid on by measurement, and either spiked down with long nails, or held down with bars.

Copes are cast in open sand, but the smaller flasks are generally covered. Then a plain top is rammed on a hard bed of leveled sand, and the runners are rammed in it. The top is then laid over the mold and weighted. It need not be staked, as the runner holes can be set over the ingates by using a pattern runner pin as a guide.

When a box is poured in open sand there is nearly as much work involved as in covering it with a top. Every separate wall of sand should be weighted, as in Fig. 2, to prevent the metal from lifting the sand. When poured in open sand the mold must also be made an inch or more deeper than the casting, and flow-off channels should be provided, as in Fig. 2, at the casting depth, because it is difficult to pour an open mold exactly full without an excess of metal. However, the top edge is always very rough and spongy and a good looking job is worth the little extra time entailed in ramming a plain top.

Electric Welder in the Steel Foundry

By B H Reddy

LOSSES in the manufacture of steel castings are greatly in excess of those entailed in gray iron foundry practice and in both open-hearth and converter plants, these will vary from 30 to 45 per cent. This shrinkage includes heads, gates, sprues and melting losses. It does not include defective castings, due to slag inclusions, short-pouring, shrinkage cracks, blow-holes, scabs, etc. If the casting contains slag, it had better be scrapped and sections that are poured short must likewise be considered total losses. If the amount which the casting is short is small, it is sometimes profitable to build up the missing metal to the required dimensions. Blow-holes usually can be filled and shrinkage cracks can be welded in such a way, that the castings will pass inspection and can be used for the purpose intended.

Castings can be welded by a number of different methods. Electric welding has been adopted in many shops and a temporary installation can be made at a small cost. All that is required is flexible copper cable, a suitable carbon with holder, a barrel or other receptacle filled with water and several iron or copper plates. Of course, a helmet and gloves must be used, which are similar to those employed generally for welders of this type. All that can be said in favor of this form of installation is its small first cost and portability, but it is wasteful of power and is disagreeable to operate. This type of welding outfit uses less than 50 per cent of the energy from the line in the arc.

The motor generator set also can be employed, which consists of a motor driving a generator. A welding outfit of this kind frequently can be made from discarded electrical equipment, which may be found at most large plants. While this type of installation is far superior to the one previously noted, nevertheless, it has a number of disadvantages. If purchased new, it is more expensive than a machine designed especially for welding in a steel foundry and it does not possess the adaptability desired to meet the varying requirements of the service demanded.

A small self-contained machine is now being installed by a number of foundrymen, which occupies comparatively small floor area, can be readily operated and it carries to the arc 80 per cent or more of the energy taken from the line. For different classes of work the current requirements vary, but after some experience, the operator can judge within less than 10 amperes the amount of current he is drawing from the line by the appearance of the arc. In addition, the amount of current flowing through the arc is regulated by the machine. This prevents a sudden overload and by the use of carbon of the proper size and sufficient current, large work can be treated successfully.

By the use of this welder, large blow-holes not only can be filled properly, but the metal will be welded thoroughly to the body of the casting. Owing to the high temperature generated by the arc, a large amount of metal can be maintained in a molten condition. The voltage for

work of this kind should range from 40 to 60, while the amperage will vary from 75 upward. For general welding work, from 225 to 350 amperes usually are required, but a careful operator can effect great economies in current consumption. Newly-welded castings should be allowed to cool slowly and should not be exposed to a current of cold air. Occasionally, the welds are hammered lightly with a hand hammer to relieve cooling strains.

As the heat at the arc is at a high temperature, it should not be directed at one spot, but should be constantly moved. This may be accomplished by giving the arc a rotary motion, thereby covering a larger area and thus avoiding the burning of the metal. If care is exercised, it will be possible to weld alloy steels successfully. Occasionally, powdered aluminum is employed when making a weld, as this forms a protective slag, thereby preventing the rapid oxidation of the metalloids. Sometimes it is desirable to use a flux for welding and for this purpose borax can be employed and should be heated and pulverized before application.

Preheating Before Welding

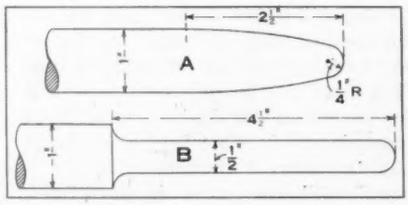
When filling openings in castings and for welding large work, preheating is desirable. When welding fractures in castings, the heat should be applied at either end, thereby extending the metal uniformly and opening the fracture. After the opening has been filled and as the casting cools, the broken parts will be drawn closely together. For preheating castings prior to welding, gasoline torches frequently are employed.

While many castings may be saved by welding, without detriment to their future use, it is not always advisable to repair defects in this way when the sections are to be subjected to tension. This is considered from a standpoint of safety and refers to the tension members of castings, such as car truck frames, bolsters, etc. However, castings of this type have been welded successfully and have given excellent service. The writer has seen many castings in which the weld made by the electric arc could not be detected after machining.

The Carbons

The carbons generally employed are 1 inch in diameter and 10 inches long, although carbons as large as 1½ inches in diameter sometimes are used. If the carbon is of the requisite degree of hardness, it will burn to the form illustrated at *A*, in the accompanying illustration, but if it is too soft, it will frequently have to be repointed. Sometimes the carbons burn to the shape shown at *B*. This reduction in diameter is caused by the disintegration of the carbon and indicates its poor quality.

The operator is not in danger of being shocked, but the eyes must be well-protected from the rays of the arc. To safeguard the head and face, a metallic hood or helmet is worn with an opening or window in front of the eyes, covered with a number of thicknesses of heavy deep blue or purple glass. Depending on the intensity of the arc, the distance from it, etc., a brief exposure of the eyes direct to its rays causes severe pains. After an elapse of a few hours, a highly inflamed condition of the eyes will result, which may last for several days. However, by exercising ordinary care, an arc welder can be used without injury to the operator and it possesses many advantages for steel foundry work.



CARBONS FOR ARC WELDING, AS REDUCED IN SIZE BY USE

Tapers for Emery Wheels

The standardization of emery wheel shapes and steel safety collars should receive the immediate attention of both manufacturers and users of grinding wheels. Unless such a standard is adopted and complied with, the use of safety shape wheels and safety collars will increase, rather than decrease the hazard attending the operation of these wheels. Many users of grinding wheels recently have undertaken to make their own safety collars and many of these do not conform to any of the standards of the market. In addition, some manufacturers of grinding wheels will make these to conform to any shape. This practice should be stopped. Formerly, the Pittsburgh Emery Wheel Co., Pittsburgh, tapered its collars ¾ inch per foot, the wheels having been tapered on both sides. Many of these collars were made with a 6-inch flat spot at the center. This has been changed to a 4-inch flat spot in the collars and all wheels now have a 6-inch flat spot.

One emery wheel works formerly tapered its collars ½ inch per foot with a 4-inch flat spot, but some years ago this taper was changed to ¾ inch to the foot with a 4-inch flat spot. Another grinding wheel company tapers its collars ¾ inch to the foot and some of these have a 4-inch and others a 6-inch flat spot.

The writer knows of a number of instances where wheels, with a ½-inch taper, have broken and large pieces became disengaged from the collars, resulting in the injury or death of the operators. On the other hand, wheels tapered on both sides with a taper ¾ inch per foot, protected by collars which fit the wheel, the collars being 4 inches less in diameter than the wheel, have resulted in practically no casualties or serious damage during the 10 years that this taper has been adopted.

Tapering of Collars and Wheels

Nearly every wheel tapered ¾ inch will break when protected with collars having a ½-inch taper and the broken pieces of the wheel will become disengaged from the collars, which will open at the rim. A wheel with sides tapered ½ inch per foot will not necessarily break if used in collars with a ¾-inch taper, but the constant use of ½-inch tapered wheels and ¾-inch tapered collars will ruin the collars for subsequent use for ¾-inch tapered wheels. This is due to the fact that the collars will spring in the center as a result of the tightening of the nut on the spindle. If more than 2 inches on the wheel is to be exposed beyond the safety collar, a safety hood should be mounted on the machine in addition to the collar. If all manufacturers of wheels will taper them ¾ inch to the foot with a 6½-inch flat spot, and if they will make all collars for wheels with a ¾-inch taper with a 4-inch flat spot, and if all users of emery wheels, who make their own collars, will conform to this standard, no further difficulty will be experienced. These specifications apply to wheels more than 12 inches in diameter. For grinding wheels 12 inches and less in diameter in the future we shall adopt a 3-inch flat spot, thereby permitting the use of collars 6 inches in diameter. This does not apply to 12-inch stubs of larger wheels. If users of grinding wheels will insist on a ¾-inch taper per foot with 6-inch flat spots, a standard can easily be established.

CHARLES D. SMITH, President,
Pittsburgh Emery Wheel Co, Pittsburgh.

Molding Cylinders By Hand and Machine

A Comparison of the Two Methods, Including Details of the Two Systems for Making Large Gas Engine Parts

IN THE development of the gas tractor with its heavy engine operating either with kerosene or gasoline, foundrymen have been called upon to make a special study of the cylinder molding problem as it affects this particular type of motor. Tractor motors are practically all of the four-cylinder type. The cylinders are cast singly, although occasionally they are cast in pairs. The methods of those foundries which have brought the molding of light automobile engine cylinders to a high state of perfection are of little value in this class of work. The molds are too heavy to be conveniently oven-dried and the quantity of cylinders required is not sufficient to justify a large expenditure for equipment or for processes in which the work is minutely subdivided. The problem, therefore, resolves itself into a question of plain molding in green sand with the aid of standard equipment.

Two general methods are employed, namely hand-molding with wood patterns and machine-molding with special metal pattern equipment. The former, of course, is the simpler and requires little rigging or equipment, but a much greater production can be obtained by machine-molding and there is no question of its ultimate economy except in cases where the quantity is limited.

Fig. 1 shows the principal features of the hand-molding method as practiced by a prominent foundry in the Twin Cities, and Fig. 2 indicates how the same problem is handled by the Gas Traction Foundry Co., Minneapolis, with the aid of an International stripping plate machine.

The molds illustrated in Fig. 1 are for cylinders 6¼ inches in diameter by 7½-inch stroke. The job is handled in a four-part, 24-inch circular cast iron flask; the drag is 10 inches; the first cheek, 5½ inches; the second cheek, 12¾ inches, and the cope, 5 inches deep. The general character of the flask equipment is clearly indicated in Fig. 1; the wood pattern is shown on the floor in front of the molds. It is split in four sections, one of which fits into each of the four parts of the flask.

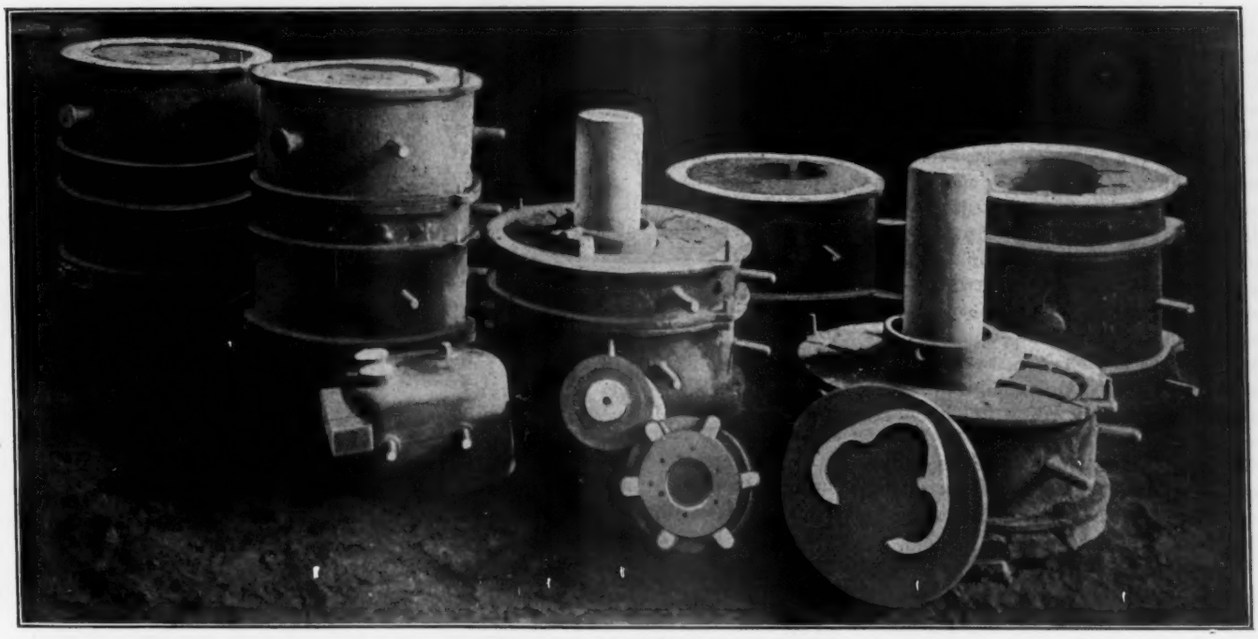


FIG. 1—METHOD OF MOLDING GAS ENGINE CYLINDERS BY HAND

Cylinder Molding by Hand

In making the mold, the drag is first rammed on a bottom board, rolled over in the ordinary manner and a parting is struck-off on top. The first cheek is then set in place and the corresponding portion of the pattern is fitted into its proper position. The cheek then is filled with sand, rammed and a proper parting made on top. After this operation is completed the second cheek and cope are handled in a similar manner. The cope, the second and the first cheeks are then successively removed, giving access to the pattern still remaining in the drag. The latter is drawn from the sand and the various parts of the mold are cleaned, patched and finished.

Before the mold can be closed the cores must be set. There are seven principal cores, including a support or print core, which is rammed in the drag before it is rolled over, a bottom, middle and top jacket core, a barrel core to which the ports are attached, a support core for the back of the cylinder head, and finally a cover core. The barrel core is first fitted in place in the drag and the other cores are then placed around it in their proper order. At the same time, the two cheeks and the cope are replaced. At the extreme right, Fig. 1, is shown the drag with the barrel and top jacket cores in place; at the left is a mold with the first cheek and bottom jacket core in position, while the four molds at the extreme left show the drag with the first and second cheeks completed, ready to receive the cope. The molds are closed by a slab core which is provided with drop gates.

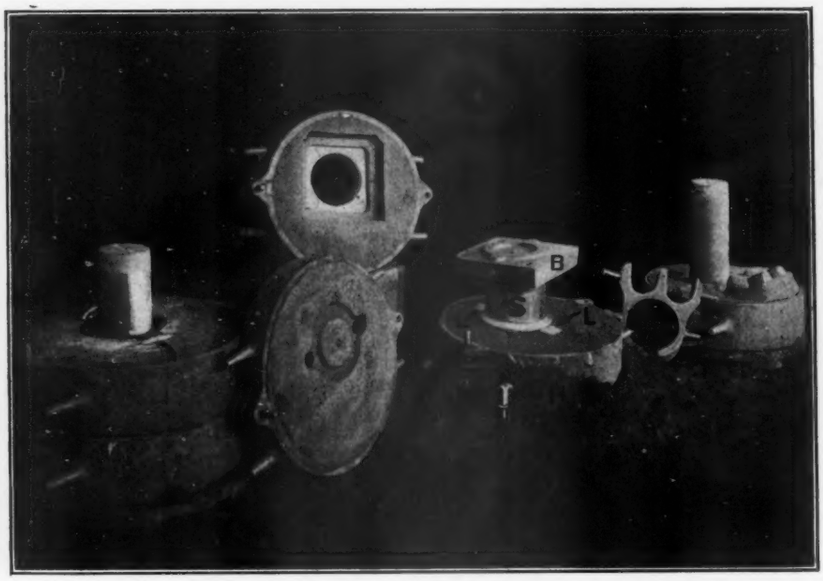


FIG. 2—MOLDING CYLINDERS ON A STRIPPING PLATE MACHINE

Turning now to the methods followed by the Gas Traction Foundry Co. in molding cylinders with the aid of a stripping-plate machine, it will be noted that the flask equipment is practically the same as that necessary for hand molding. The general features of the machine-molded job are illustrated in Fig. 2. An 18-inch square, International stripping plate machine with 12-inch draw is employed. The machine is sunk in a pit so that the table is flush with the floor level. This is done to save labor in lifting the heavy molds and in order to have the work at a height most convenient for the workmen. The stripping mechanism of the machine is operated by bevel gears connected to a lever which projects slightly above the floor as shown at *H*, Fig. 2.

The casting weighs 175 pounds, the cylinder being 6½ inches in diameter with an 8-inch stroke. The drags are rammed by hand, using a special cast iron bottom board and the two cheeks and cope are made on the machine. Four men are employed on the job; two work on the machine, the third rams the drag and helps the fourth to set the cores and close the molds. Twenty-four flasks constitute an average day's work. The flasks are cast iron, 23 inches in diameter inside, the drag and first cheek being 7 inches, the second cheek 9 inches and the cope, 4 inches deep.

In Fig. 2, the drag is shown at the extreme right with the barrel core in place. The top jacket core is shown in front of the drag. The metal bottom board on which the drag is rammed, takes care of the irregular shape of the top of the cylinder. A dry sand support or print core is placed on the pattern and is rammed in the drag as previously described for a hand-molded job. When the pattern is drawn, the support core forms the bottom of the mold cavity in the drag and the barrel core rests directly on it. A small chaplet is placed on the support core to hold up the rear end of the top jacket core.

The stripping plate machine is used for making the two cheeks and the cope. In Fig. 2 the first cheek is shown in place on the machine, the second is standing up at the rear, while the cope is at the left leaning against one of the open molds.

The pattern is rather complicated but is ingeniously constructed. It consists of a hollow cylindrical shaft portion *S*, Fig. 2, to which is fitted the square base *B*, and the two movable lugs *L*. The square base is doweled to the cylindrical portion of the pattern and forms that part of the cylinder which is bolted to the crank case. The shaft of the pattern being hollow, the lugs *L* may be drawn inwardly by a wrench and linkwork until they are flush with the surface; this permits the pattern to be stripped out of the mold.

In operating the machine, the first cheek is placed on the table, rammed and struck-off so that it appears as indicated in Fig. 2. The second cheek then is set in place, and rammed and is followed by the cope; the latter is removed and then the detachable square portion of the pattern is drawn from the sand, leaving the square cavity seen in the second cheek. The lugs *L* are next drawn into the pattern, which is then stripped out of the first and second cheeks. These operations require the labor of two men for about 17 minutes.

In closing the molds the top, middle and bottom jacket and the barrel cores are set in the drag and the cheeks are then placed in position as shown at the extreme left in Fig. 2. The metal is poured into the mold as hot as possible.

Foundry Exhibit in England

An exhibit of foundry equipment and supplies will be held in London, Eng., June 14 to 28, at the Royal Agricultural hall. As the annual convention of the British Foundrymen's Association will be held in London from June 20 to 26, the members of this organization will have an opportunity to inspect the exhibits. The official visit of the members of this society will be made on June 21. The exhibit will be conducted by the Foundry Trades Exhibition, 124 Holborn, London, E. C.

FIG. 3—BARREL CORES MADE IN METAL CORE BOXES

Applying Chemistry in the Plating Room---II

How the Determinations for Acidity and Alkalinity Are Made, With Examples Showing the Exact Calculations

By E P Later

IN GENERAL, acidity refers to the presence of free or uncombined acid in a solution, and is detected by the change of color produced in certain substances known as indicators, when they are introduced into the mixture to be tested. It can readily be appreciated that the delicacy of the test depends on the sensitiveness of the indicating substances employed, as it is a well-known fact that they vary greatly in this respect. Some will show a change of color in the presence of very small quantities of acid, while others require a relatively large amount. In a solution which is only very slightly acid, some indicators will show acid and some alkaline. Furthermore, it should be noted that some salts react acid or alkaline to certain indicators, when no acid or alkali is present.

Indicators

This is not said to destroy the operator's faith in indicators, for they really are indispensable, but merely to point out the fact that a good deal depends on the selection of the proper one. Just because an indicator works in one place is no sign that it will in all others. Long experience has shown that certain indicators are best adapted for certain purposes and for use under definite conditions and it will be well, therefore, to follow directions closely, especially those relating to the conditions of the test and the reagents employed.

Before proceeding to the description of any methods, it must always be borne in mind that cleanliness plays a great part in all quantitative chemical work. Beakers and other apparatus should be rinsed out thoroughly with distilled water before being used; stirring rods must be washed well when they are taken out of one solution and put into another and the same applies to pipettes. An occasional scrubbing, inside and out, with warm water and soap helps to keep all apparatus clean and is especially desirable in the case of burettes. Small wire brushes made for this purpose can be purchased and are very useful.

For the estimation of free acid a standard solution of tenth-normal sodium carbonate or bicarbonate will be required. It may be purchased or easily made by weighing out 5.305 grams of pure sodium carbonate or 8.406 grams of pure sodium bicarbonate, dissolving it in a small amount of distilled water, with which it also is diluted to 1,000 c. c..

To determine the strength of this solution, rinse one of the burettes with distilled water, then with a small amount of a standard solution of tenth-normal sulphuric acid and finally fill with this. The tap or clamp should be opened wide for a second or two so that the rush of liquid will sweep out the air bubbles which are contained in the burettes. If the tap is removed before using, apply vaseline and replace, and it will be found to work more easily and will prevent leakage.

The tap is next slowly opened and the liquid is allowed to run out until the lowest part of the curved surface at the top of the column, known as the meniscus, exactly coincides with the top graduation mark of the burette. Then clean a 10 c. c. pipette by drawing it full of distilled water two or three times and rinse with a small quantity of the alkali solution to be tested.

Measuring the Solution

Ten cubic centimeters of solution are measured in the pipette by drawing up such a quantity that the column rises a little higher than the graduation mark around the stem. The tube is removed from the mouth and one finger is placed tightly over the end. This must be done very quickly, but a little practice will be sufficient to acquire skill. By slowly releasing the pressure of the finger the liquid can be allowed to run out drop by drop until the lowest part of the curved surface coincides with the graduation mark. Any excess of liquid at the end of the pipette is drained off by touching it to the side of the beaker or flask containing the solution.

The contents of the pipette are then run into a clean beaker and about 15 c. c. of distilled water and two or three drops of methyl orange are added; the standard acid is next carefully run in from the burette until a single drop produces a permanent red color. The burette reading is then taken. It is important to stir the solution thoroughly while titrating. The methyl orange is prepared by dissolving 0.1 or 0.2 grams in 100 c. c. of distilled water. A little practice will enable the operator to tell the color change with great accuracy. Only two or three drops should be used, as indicators are less sensitive if much is used.

Calculation

Theoretically, 1 c. c. of the carbonate solution should contain 0.0053 grams of sodium carbonate or 0.0084 grams of sodium bicarbonate, and since 1 c. c. of N/10 sulphuric acid contains 0.0049 grams acid, 10 c. c. of the former should exactly neutralize 10 c. c. of the acid. Then 1 c. c. of the carbonate solution would be equivalent to 0.0049 grams of sulphuric acid.

In any case, the value of 1 c. c. of the solution in grams of acid may be found by dividing the number of grams of acid required for neutralization by the number of cubic centimeters of alkali taken.

Thus, if 10 c. c. of carbonate solution are taken and require 10.2 c. c. of N/10 sulphuric acid for neutralization, $\frac{10.2 \times 0.0049}{10} = 0.004998$. That is, each cubic centimeter of alkali solution is equivalent to 0.005 grams of sulphuric acid. Its value in terms of any other acid may be found by means of the proportion 0.0049:X::Y:Z when X = equivalent of 1 c. c of alkali solution in grams of sulphuric acid, Y = weight of acid in 1 c. c. of N/10 solution of the acid in question and Z = value of 1 c. c. of alkali solution in grams of the acid required. For instance, if 1 c. c. alkali = 0.005 grams of sulphuric acid, what is its value in terms of nitric acid? One c. c. N/10 nitric acid = 0.0063 grams acid, therefore, 0.0049:0.005::0.0063:X. Solving, X = 0.00643.

Two examples will suffice to show the procedure in determining the amount of acid in a solution.

To determine free acid in a copper plating solution:

Pipette 10 c. c. of the solution into beaker, dilute with 25 c. c. of dis-

tilled water, add two or three drops of methyl orange and titrate with N/10 sodium carbonate or bicarbonate, stirring carefully, until the free acid is neutralized, as shown by the color of the solution changing from violet to light green.

Calculation

(a) If the alkali solution is exactly tenth-normal, each cubic centimeter will be equivalent to 0.0049 grams of sulphuric acid. Therefore, by multiplying the number of cubic centimeters required by 0.0653, the result is expressed in ounces of acid per gallon.

If it is desired to express the result as per cent of acid, it is only necessary to multiply the number of cubic centimeters of alkali required by 0.049 (0.0049 × 10) and point off.

(b) If the alkali is not exactly tenth-normal, its value per cubic centimeter in grams of sulphuric acid should be multiplied by 100 times the number of cubic centimeters required and this result divided by 7.5 will give the ounces of free acid per gallon.

The result may be expressed as per cent of acid by multiplying the value per cubic centimeter of the alkali solution in gram of acid by 10 times the number of cubic centimeters required.

A little experimenting will indicate the proper degree of acidity for the most efficient operation of the copper solution, or this could easily be determined by making up a small quantity of fresh solution using the regular formula and estimating the acid in it. Having once determined the proper degree of acidity, it is easy to maintain this in the plating tanks by making a test every few days, and adding sulphuric acid or copper carbonate according as the solution is low or high in acid.

In adjusting the reaction, the addition of 1.65 c. c. of concentrated sulphuric acid per gallon will increase the acid content 0.1 ounce, while the addition of 3.77 grams of copper carbonate per gallon will decrease the free acid 0.1 ounce.

To determine free acid in a pickling solution:

In such a case, the amount of acid present is so large that only a small quantity of solution should be titrated or otherwise several hundred cubic centimeters of standard alkali might be required. To save time, 1 c. c. may be drawn off by a pipette and run into a beaker, then diluted with 20 or 25 c. c. of distilled water and titrated as before.

Perhaps the best way is to run 10 c. c. of the solution to be tested into a volumetric flask of 100 or 250 c. c. capacity and carefully dilute to the mark, after which any desired quantity can be withdrawn and titrated.

Assuming that 10 c. c. of the original solution were diluted to 100 c. c. and that 10 c. c. of this mixture were titrated, it is evident that in reality only 1 c. c. of the original was titrated. In other words, each 10 c. c. of the diluted mixture contains 1 c. c. of the original. In the same way, if 10 c. c. had been diluted to 250 c. c., 25 c. c. of this mixture would contain 1 c. c. of the original.

When calculating the results of such a test it is important to know how many cubic centimeters of the *original* were titrated, then the weight of 100 c. c. can be figured, and the result expressed as per cent by pointing off or as ounces per gallon by multiplying by 1.33.

Alkalinity

Alkalinity has reference to the presence of hydroxides, especially those of the alkalis and alkaline earth metals and of the carbonates and bicarbonates of these metals. It is detected in the same manner as acidity; that is, by the use of certain indicators, which change color in the presence of alkaline compounds. For the determination of alkalinity, standard solution of tenth normal sulphuric acid will be required. This may be purchased or made up by pouring about 4 c. c. of concentrated sulphuric acid into a liter of distilled water and mixing thoroughly.

Standardization is carried out as given under the standardization of N/10 sodium carbonate, except that 10 c. c. of the acid are taken and, after dilution to 25 c. c. with distilled water and addition of two or three drops of methyl orange, titrated with an alkali solution of known strength. If the alkali is exactly tenth normal, each cubic centimeter will be equivalent to 0.0049 grams of sulphuric acid. If made up as directed, the acid will be a little too strong and must be diluted to make it exactly tenth normal.

Theoretically, 10 c. c. of N/10 sulphuric acid should require 10 c. c. of N/10 alkali. If more is required, it shows that the acid solution contains more than 4.9 grams acid per liter and needs to be diluted and the amount of water to be added may be figured from the amount of carbonate solution required. Thus, if 11.3 c. c. instead of 10 were necessary to neutralize 10 c. c. of the acid, the following proportion, 10:11.3::1,000:X shows that there is as much acid in 1,000 c. c. of the solution tested as there should be in 1,130 c. c. of exactly tenth normal acid. If, then, 1,000 c. c. be taken and diluted to 1,130 c. c., the resulting solution will be of the exact strength or nearly so, or 885 c. c. could be taken and diluted to exactly 1 liter. After dilution, it should be tested again to make sure that it is right.

Alkalinity of Zinc Solution

One cubic centimeter of N/10 sulphuric acid is equivalent to 0.0053 grams of sodium carbonate or 0.0084 grams of sodium bicarbonate.

The solutions of some metals used in plating, zinc and nickel, for example, show an alkaline reaction to methyl orange when the amount of free acid in them falls below a certain point. Thus, they are to all intents and purposes alkaline and the amount of alkalinity may be determined, even though in reality free acid is still present. Since this phenomenon depends on the behavior of the indicator rather than on the solution itself, it is important always to use the same indicator when testing a certain solution.

To determine alkalinity in zinc plating solutions:

Pipette 5 c. c. of solution into a beaker; add 25 c. c. of distilled water and two or three drops of methyl orange and titrate with N/10 sulphuric acid until the color changes to reddish brown.

This test is really a measure of the amount of free acid and since there is no free alkali present, the result cannot logically be expressed in terms of this.

When plating these metals, it is important that a certain definite degree of acidity should be present. This will vary somewhat in different formulas and the best way, probably, of determining it is to test the solution when it is first made or working satisfactorily, or to make up a small quantity of fresh solution and determine the degree of alkalinity. Instead of expressing the result as per cent or in ounces per gallon, it is easier to keep the solution so adjusted that a certain quantity of N/10 sulphuric acid is required to neutralize, say, 5 c. c. If, then, it is found that it works best when 0.3 c. c. of acid are required to do this, the solution should be kept at that point by the addition of sulphuric acid or zinc oxide according as the alkalinity is high or low.

As a suggestion, approximately 0.22 c. c. of concentrated commercial sulphuric acid are required to reduce the observed alkalinity of a gallon of

solution 0.1. Ninety-five grams of zinc oxide are necessary to increase the alkalinity of one gallon of solution 0.1.

The nickel solutions may be tested in the same way except using Congo red, two drops of a strong solution, as indicator and titrating until the red color changes to a greenish blue. Having once determined the proper reaction for the bath, it may be kept at this point by the addition of sulphuric acid or nickel carbonate, made into a paste with water.

Value of Cleaning Compounds

Another useful purpose which the alkalinity estimation can accomplish is in determining the relative value of various cleaning compounds, maintaining cleaning solutions at the proper strength, and eliminating waste by preventing them from being thrown out while there is still good material present.

The alkalinity of such compounds may be due to hydroxides, carbonates or bicarbonates, principally of the alkali metals, sodium and potassium. By proper selection of indicators it is possible to determine the amount of each kind of alkalinity present.

Use is made of the fact that methyl orange reacts alkaline to all of the above radicals, while phenolphthalein is alkaline only to hydroxides and carbonates. It is important to note, however, that this indicator must be used in *cold solutions* and also that it cannot be employed when carbon dioxide is set free nor in the presence of ammonia.

The process consists in titrating the unknown solution with standard acid, using phenolphthalein as the indicator until the red color disappears. The burette reading is then taken, a few drops of methyl orange are added and the titration is continued until the formation of a permanent pink or red color. The reading is again taken and the results are calculated.

A little consideration of the previous statement regarding the relative sensitiveness of methyl orange and phenolphthalein will show why such a determination is possible.

When an acid acts upon sodium carbonate the neutralization takes place in two stages, the first of which consists in the formation of sodium bicarbonate. When this is acted on by a further quantity of acid, it is decomposed, forming the sodium salt of the acid used and setting free carbon dioxide. Thus, with sodium carbonate and sulphuric acid, the first stage of the action may be represented.

$2Na_2Co_3 + H_2SO_4 = 2HNaCO_3 + Na_2SO_4$.

With more acid:

$2HNaCO_3 + H_2SO_4 = Na_2SO_4 + 2CO_2 + 2H_2O$.

Since the bicarbonate does not show an alkaline reaction to phenolphthalein, the disappearance of the red color marks the point where all the normal carbonate has been converted into the bicarbonate.

Therefore, if this indicator is added to a solution containing sodium hydroxide and carbonate and the whole titrated with acid, the disappearance of the red color will show the point where all of the hydrate and one-half of the normal carbonate alkalinity have been neutralized. The alkalinity still remaining is due to bicarbonates alone and these were present originally or were formed by the action of the acid on the normal carbonates. Since methyl orange reacts alkaline to these, they may be titrated, using this indicator, until they are completely decomposed.

Four Combinations of Results

It is evident that four combinations of results are possible. Using the abbreviations M.O. = methyl orange and Phth. = phenolphthalein, in any titration with these two indicators:

1.—If the alkalinity to Phth. = O, then the alkalinity to M. O. is due to bicarbonates alone and hydroxides and carbonates are absent.

2.—If the alkalinity to Phth. is just one-half of the *total* alkalinity to M. O., it is due to normal carbonates alone and hydroxides and bicarbonates are absent.

3.—If the alkalinity to Phth. is less than one-half the total alkalinity to M. O., then both carbonates and bicarbonates are present and may be determined by these formulae:

Carbonates = 2 Phth., and,
Bicarbonates = M. O. — 2 Phth.

This means that twice the quantity of acid required for neutralization to Phth. must be used in calculating the amount of carbonates present.

When calculating the bicarbonates, M. O. — 2 Phth. means that twice the acid required for neutralization to Phth. when subtracted from the total amount of acid required (Phth. + M. O.) represents the acid necessary to take care of the bicarbonates. In other words, if the titration with Phth. required 5 c. c. of acid and 11 were required with M. O., the total acid is 5 + 11 = 16 c. c. Then the carbonates present required 2 Phth. = 10 c. c. of acid for neutralization and bicarbonates required 16 — 10 = 6 c. c. of acid.

4.—If the alkalinity to Phth. is greater than one-half that to M. O., then bicarbonates are absent and the alkalinity is due to carbonates and hydroxides and they may be determined as follows:

Carbonates = 2 (M. O. — Phth.).
Hydroxides = M. O. — 2 (M. O. — Phth.).

Alkalinity of Cleansing Solution

These relations may be somewhat hard to understand, but it is believed a little study of the formulae and principles involved will make them clear and there is no doubt that it is well worth the trouble.

If it is desired merely to determine the *total* alkalinity of a cleansing solution, say, it is only necessary to pipette 5 or 10 c. c., depending on the strength, into a beaker, dilute to 25 c. c. with distilled water, add two or three drops of methyl orange or litmus and titrate until the formation of a permanent pink or red color (blue, if litmus is used).

Since the alkalinity thus determined may be due to hydroxides, carbonates or bicarbonates, or any combination of these, it is hardly logical to express the result as a percentage of any one of these. It is better, therefore, to report the alkali as sodium oxide, Na_2O. One c. c. of N/10 sulphuric acid is equivalent to 0.0031 grams of this; therefore, it is only necessary to multiply the number of cubic centimeters of acid required by 0.0031 and then by 10 or 20, depending on whether 10 or 5 c. c. of solution were taken for analysis. The result is per cent of alkali as Na_2O.

If it is desired, however, to know the amount and kind of alkalinity, 5 or 10 c. c. of the solution are run into a beaker, diluted to 25 c. c. with distilled water, a drop or two of phenolphthalein (1 gram in 100 c. c. grain alcohol) added and the whole is titrated with N/10 sulphuric acid until the red color just disappears. The solution must be stirred thoroughly and great care must be exercised that the acid be added slowly enough so that this point is accurately determined. The burette reading is taken, then two or three drops of methyl orange are added and the titration is continued to the appearance of a permanent pink color. The reading is again taken and from these data the results are calculated. It is often a good idea to check the results and get the "methyl orange alkalinity" by titrat-

ing a second portion with this indicator. The phenalphtholein plus the methyl orange alkalinities from the first test should equal that given by the latter when used alone.

This will vary according to the data, but, briefly, it consists in determining the amount of alkali present as shown by the two indicators and then expressing this as caustic, carbonate or bicarbonate alkalinity.

Examples

An example or two will serve to illustrate this.

Suppose 10 c. c. of a solution were titrated and 5 c. c. N/10 sulphuric acid were required for neutralization to Phth. and 7 c. c. for M. O.

Since 1 c. c. of N/10 sulphuric acid is equivalent to 0.0031 grams of sodium oxide, it is apparent that there are $5 \times 0.0031 = 0.0155$ gram of alkali present as hydroxide or normal carbonate, and calculated as Na_2O, since Phth. reacts alkaline only to these. Also, since the *total* or M. O. alkalinity is 12 c. c., there are present $12 \times 0.0031 = 0.0372$ gram of alkali in the form of hydroxide, carbonate or bicarbonate and calculated as Na_2O.

By referring back to the table, it is seen that this falls under example No. 3. Carbonates and bicarbonates are both present then, and according to the formula, carbonates = 2 Phth. $= 2 \times 5 = 10$ c. c. N/10 sulphuric acid, $10 \times 0.0031 = 0.031$, and since 10 c. c. of solution were titrated multiplying this result by 10 gives 0.31 which is the amount of alkali, calculated as Na_2O, present in 100 c. c. of solution; 100 c. c. = 100 grams very closely, so that equals 0.31 per cent present.

Converting Na_2O to sodium carbonate, Na_2CO_3, we find that 62.1:106.1:: 0.31:X; X = 0.529 per cent of sodium carbonate.

In like manner bicarbonates = M. O. — 2 Phth. = 12 — 10 = 2 c. c. N/10 sulphuric acid; $2 \times 10 \times 0.0031 = 0.062$ = grams of alkali calculated as Na_2O in 100 c. c. of solution, which is equivalent to 0.062 per cent. This is really present, however, as bicarbonate, so converting Na_2O to $HNaCO_3$, 31.05:84.06::0.062:X, X = 0.167 = per cent of sodium bicarbonate.

Again, suppose it were desired to determine the kind and amount of alkali present in a sample of soda ash, crude potash or similar material.

Approximately 5 grams should be weighed out, dissolved in distilled water and diluted to exactly 250 c. c. in a volumetric flask. Let us assume that 5.05 grams were taken.

Pipette 5 c. c. of the solution into a beaker, add two drops phenolphthalein and titrate with N/10 sulphuric acid until the pink color just disappears. Take the reading, then add a drop or two of methyl orange and titrate again until the yellow color changes to pink. Assume that 8.7 c. c. were required for neutralization to Phth., and 7.45 for M. O. Then the total or M. O. alkalinity is equivalent to 16.15 c. c. N/10 sulphuric acid.

By referring to the list of possible cases, it is seen that in this instance hydroxides and normal carbonates are present, also carbonate = 2 (M. O. – Phth.). Thus, acid used in saturating the carbonates = 2 (16.15 — 8.7) = 14.90 c. c.; $0.0031 \times 14.90 = 0.0462$ = grams alkali as Na_2O in 5 c. c., which represents 1/50 of the total weight of the material taken. Then $\frac{0.0462 \times 50}{5.05} = 0.457$ = alkali as Na_2O in 1 gram. Converting Na_2O to sodium carbonate, Na_2CO_3, 62.1: 106.1::0.457:X, X = 0.781; moving the decimal point two places to the right, we express the result as the per cent of sodium carbonate, 78.1.

By the formula, hydroxides = M. O. — 2 (M. O. — Phth.) = 16.15 — (16.15 — 8.7) or 1.25 c. c. N/10 sulphuric acid. Then, $1.25 \times 0.0031 = 0.003875$ gram of alkali as Na_2O in 5 c. c. of solution which is equivalent to 1/50 of total weight of material taken; $\frac{0.00387 \times 50}{5.05} = 0.0383$ gram alkali in 1 gram material. Converting Na_2O to sodium hydroxide, NaOH, 31.05:40::0.0383:X, X = 0.049 = gram of NaOH in 1 gram material, or, moving the decimal point two places to the right, the result is expressed as per cent, 4.9.

McLain's System

A 40-page booklet, entitled "Semi-Steel", has been issued by McLain's System, Goldsmith building, Milwaukee, which is devoted to the manufacture of semi-steel and relates to the experiences of students of this school in the production of castings of this metal. A large number of testimonial letters are included, as well as data covering the various types of castings that are being made by the addition of steel scrap to gray iron mixtures. Another booklet, containing 16 pages, outlines McLain's course, which provides for instruction in the composition of iron, mixing by analysis, general foundry practice, cupola practice, the production of semi-steel and chilled castings, etc.

New Flexible Hose

A new type of flexible hose for steam and pneumatic service, which consists of high grade rubber hose protected against outward injury by metal, is being manufactured by the H. W. Johns-Manville Co., New York City. The metal protection is in the form of a ribbon with crimped edges, which forms, when wound, a continuous, interlocking, flexible spiral, which is claimed to be practically pressure-tight without the inner tube. As the interlocking construction of the spiral restricts the curvature, sharp bends are impossible. Consequently, the inner tube cannot kink or flatten and is always open to its full diameter, permitting an unrestricted flow of steam, gas or fluid.

Owing to its unusual strength, the metal protection is practically proof against damage. Actual service tests show that it will resist a crushing strain of 300 to 800 pounds to each four turns of the spiral, depending on the size of the hose, while it is capable of withstanding the highest internal working pressures. The substantial construction of the metal protection permits the use of a much lighter inner tube than is ordinarily employed. The inner tube is not subjected to any pulling strain as the armor is stretched to its maximum length before the hose is inserted. Specially designed malleable iron or brass couplings are furnished with each length of hose. This coupling is practically a union of three pieces, consisting of an outer sleeve into which the armor is threaded and riveted, the internal nipple, tapered at one end to fit tightly in the inner tube and the lock or binding nut which serves to wedge the internal nipple into the inner tube and hold it firmly against the inner walls of the outside sleeve. This combination hose can be furnished in any length and in any inside diameter up to 12 inches.

The John Hill Co.

The John Hill Co., Cincinnati, has been organized by John Hill, to engage in the manufacture of foundry facings of all kinds, core compounds and partings. Mr. Hill, Hill & Griffith Co. for many years, has been engaged in the foundry supply and equipment manufacturing business for 28 years and is well known in the foundry trade throughout the United States and Canada. A plant has been established at 2109 South street, where a large site has been obtained of sufficient size for future extensions.

Ancient Cupolas Render Efficient Service

Two Old Style English Furnaces for Melting Gray Iron in a New Jersey Foundry Are Described in Detail

AT THE plant of the General Foundry Co., Boonton, N. J., two cupolas are operated daily, which were installed about 75 years ago. Despite the fact that they have since been in almost constant use, and have been through two fires, necessitating the entire rebuilding of the plant on one occasion, they are still, for all practical purposes, as good as when they were new.

These cupolas were originally brought over from England at the time of the Mexican war by the old New Jersey Iron Co., which at that time owned the Boonton Iron Works. The plant then consisted of two blast furnaces, rolling mills, nail mills, cooper shop and saw mill, employing a total of almost 2,000 men. The foundry was added solely for the purpose of furnishing castings for the other departments of the plant.

As shown in the accompanying illustrations, the hearths or lower portions of these cupolas are barrel-like in construction, being built-up of cast iron staves which are held together by iron hoops. In the larger of the two cupolas, the diameter at the bottom of the hearth is 60 inches and at the top, 30 inches, the hearth being 10 feet high. In the smaller cupola, the lower part of the hearth is 40 inches in diameter and the upper part, 20 inches. The hearth is 10 feet high. Both furnaces are lined with standard fire brick. Above the hearths are placed the usual cylindrical stacks, thus giving each cupola an overall height of 35 feet. The smaller of the two cupolas still retains the original stack; recently, however, the stack of the larger cupola was replaced with a new one, as the old stack had been burned out.

The Small Cupola

The cupolas are located in one corner of the foundry and are bricked-in. The smaller cupola, at the right in Fig. 1, is provided with a box-like chamber above the barrel-shaped section. This is 44 inches high and 48 inches square. At one side is the charging door, which is two feet square. As the bottom of the charging door is only six inches above the level of the platform, the work of charging is rendered extremely trying because of the exposure of the workmen to the flame. This form of construction was also originally embodied in the larger of the two cupolas, but when the new stack was added recently, it was decided to do away with this feature, and the charging door is now sufficiently elevated above the level of the charging platform to render the work of the cupola tender more comfortable.

The small cupola is only used occasionally, as it is difficult to melt more than five or six tons in one heat. The larger installation has a capacity of 15 or 16 tons per heat. The bed charge of the latter consists of 800 pounds of coke and 2,000 pounds of iron; the subsequent charges are uniformly 100 pounds of coke and 1,000 pounds of iron. Limestone is used generally on the last two charges only, and at the rate of 50 pounds for each charge.

The wind boxes of these cupolas are rectangular, seven inches wide and nine inches high. They com-

FIG. 1—TAPPING SIDE OF TWO OLD ENGLISH CUPOLAS IN A NEW JERSEY FOUNDRY. THE CHARGING FLOOR, IT WILL BE NOTED, IS SOMEWHAT RESTRICTED IN AREA

pletely encircle the hearths about 18 inches above the bottoms, the blast entering the hearths through seven tuyeres in the large furnace and five in the small melting medium. The blast is furnished by a No. 7 Sturtevant fan and is transmitted to the wind boxes through galvanized iron pipes. The fan, as well as the remainder of the machinery at this plant, is operated by a turbine water wheel which is placed about 15 feet below the level of the ground. The water descends 30 feet through a flume, three feet in diameter, which is fed from the Morris canal, flowing past the plant. The pressure at the head of this flume is 160,000 pounds. Occasionally, the water in the canal runs low and it is then necessary to wait until the water reaches the usual level before a heat can be taken off.

The old Boonton Iron Works, after it had been operated for many years by the New Jersey Iron Co., passed into the hands of Fuller, Lord & Co., and still later it became known as the Boonton Iron & Steel Co. The principal product, prior to the time wire nails were introduced, was cut nails. Later, when the plant became the property of the J. Cooper Lord estate, the various departments were separated and the foundry was leased to H. N. Hubbard, who operated it from 1886 to 1889 as an agricultural works. J. S. Cunningham, who acted in the capacity of foreman for Mr. Hubbard, and who worked as a molder at the Maher & Flockhart foundry in Newark, N. J., from 1899 to 1903, organized the German-American Foundry Co. in the latter year. His partners were H. Kruger, John Sharkey and Oscar Rohland, all of whom had been employed as molders at the Maher & Flockhart plant. This company was dissolved shortly afterward and the General Foundry Co. was organized with J. S. Cunningham as president and A. K. Barker as treasurer. The company maintains an office at 149 Broadway, New York City. Its principal products are machinery castings, columns, column bases, grate bars, etc.

The Use of Titanium

Suggestions for the use of ferro carbon-titanium in the manufacture of steel castings are contained in an exceedingly interesting 48-page booklet, issued by the Titanium Alloy Mfg. Co., Niagara Falls, N. Y. For making open-hearth steel containing 0.30 per cent carbon and upwards, all recarburizers, except small additions of coal or coke, and the major portion of deoxidizers, except titanium, should be added to the steel in the furnace before tapping and the ferro carbon-titanium should be added to the steel in the ladle as the metal flows from the furnace. All necessary additions to the steel in the ladle, except titanium, should be added as quickly as practicable after the steel begins to run into the ladle. The titanium should be added gradually and this addition should be completed just before the slag begins to run. In all cases the titanium addition should be the last to be made to the steel and after the ladle is filled, it should be held at least eight minutes before commencing to pour.

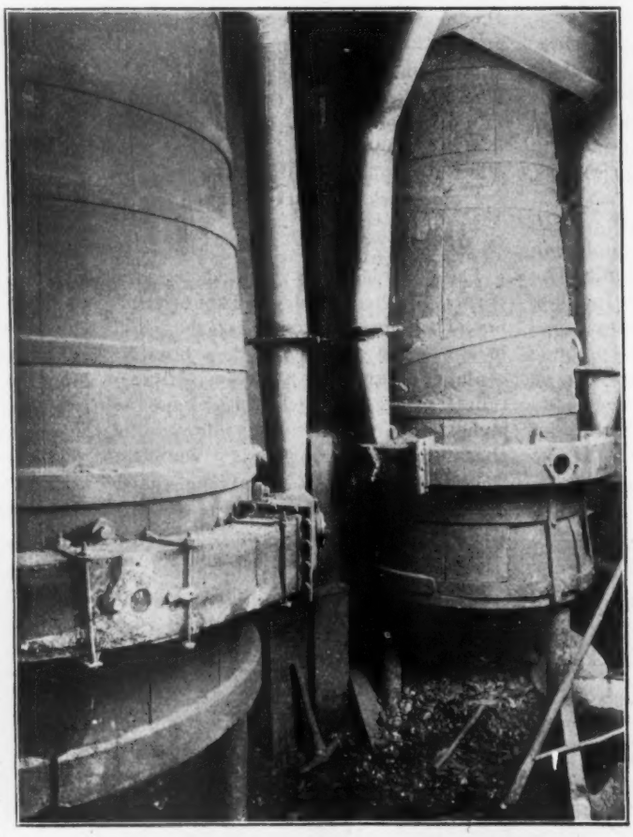


FIG. 2—REAR VIEW OF THE CUPOLAS, SHOWING THE BLAST BELTS, BLAST PIPES AND BARREL-LIKE CONSTRUCTION

When making basic open-hearth steel containing carbon under 0.30 per cent, all deoxidizers, except electro-silicon and ferro carbon-titanium, should be added to the bath of metal in the furnace. The electro-silicon should be added immediately after the steel begins to run into the ladle and before any titanium is added, the silicon addition should be completed. In the majority of cases, from three to five pounds of ferro carbon-titanium per ton of steel melted have been found sufficient. When the ladle is half full of steel, the addition of ferro carbon-titanium should be commenced. This addition should be made gradually, so that the entire amount shall be distributed slowly, but completed before the slag begins to run. The size of the ferro carbon-titanium to be used and the length of time of holding the ladle after filling must be determined by the size of the heat. For heats of 25,000 pounds and less the ½-inch size should be used and the steel should be held in the ladle at least five minutes before pouring. For larger heats the 1 to 2-inch size should be used and the steel should be held in the ladle at least eight minutes before pouring.

When making crucible steel, ferro carbon-titanium, ⅛-inch size, should be placed in the crucible, about 2 inches above the bottom of the charge and should be well surrounded by the materials in the pot. When the steel from several pots is emptied into a reservoir ladle, add the titanium when one-fourth the pots have discharged their contents and follow with the balance of the steel from the heat. When practicable, the treated steel should be held at least three minutes. The percentage of ferro carbon titanium to be used in the crucible steels should always be governed by the quantity of impurities to be removed, which varies with the quality of stock employed.

For steel to be made in Tropenas and other small converters, the major portion of the deoxidizers, except ferro carbon-titanium, should be added to the bath of the metal in the converter at the conclusion of the blow. Care should be exercised to provide some form of skimmer to prevent the slag from running into the ladle with the metal during teeming. When teeming

the metal from the converter into the ladle, first add the recarburizer and the remaining portions of deoxidizers other than the ferro carbon-titanium. Immediately thereafter, the addition of the ferro carbon-titanium should be made gradually into the stream of metal flowing into the ladle. After the ladle is filled, the steel should be held at least two minutes before beginning to cast. For this class of converter steel, ferro carbon-titanium, ¼ inch size, is recommended.

Molding Large Crank Cases

The economy of the jarring machine for making molds for heavy gray iron castings was pertinently illustrated by a large crank case job recently handled in the foundry of the Minneapolis Steel & Machinery Co., Minneapolis. The crank case was for a heavy, two-cylinder gasoline motor and the casting weighed about 1,000 pounds. The job was specially difficult on account of the large size of the casting in proportion to its weight and also because the average thickness of the metal did not exceed ½ inch.

The mold was made in a two-part, cast iron flask, 52 inches long and 39 inches wide, the drag having been 39 inches and the cope, 22 inches deep. The drag consisted of two sections bolted together. The pattern was wood, made in two parts, and each part was attached to a heavy dry sand bottom board. The two

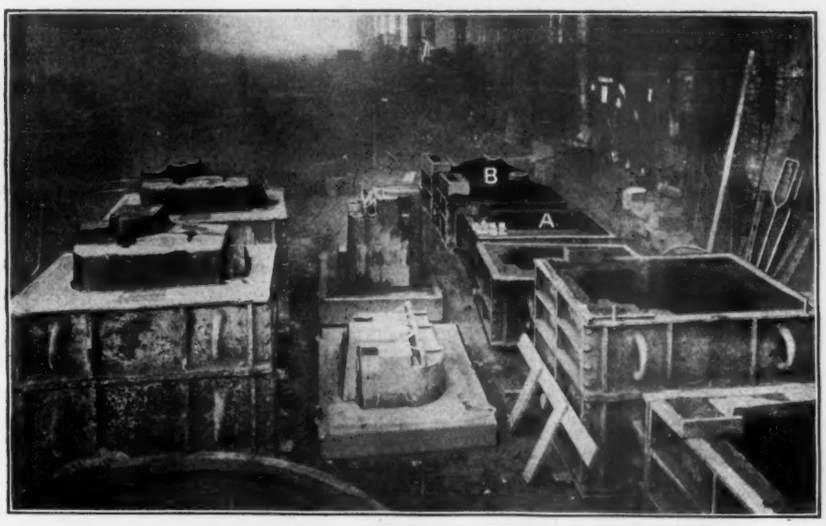


FIG. 1—JAR-RAMMED MOLDS FOR A HEAVY CRANK CASE

portions of the pattern with their bottom boards are shown in the center of Fig. 1. In the same illustration, a finished drag ready to receive the cores is shown in the foreground at the right, while at the left, *C*, is the drag with the cores in place ready to receive the cope. At *A* are shown two copes turned over for finishing and patching, while at *B* are two completed copes with their runner boxes in place. Fig. 2 illustrates the core boxes.

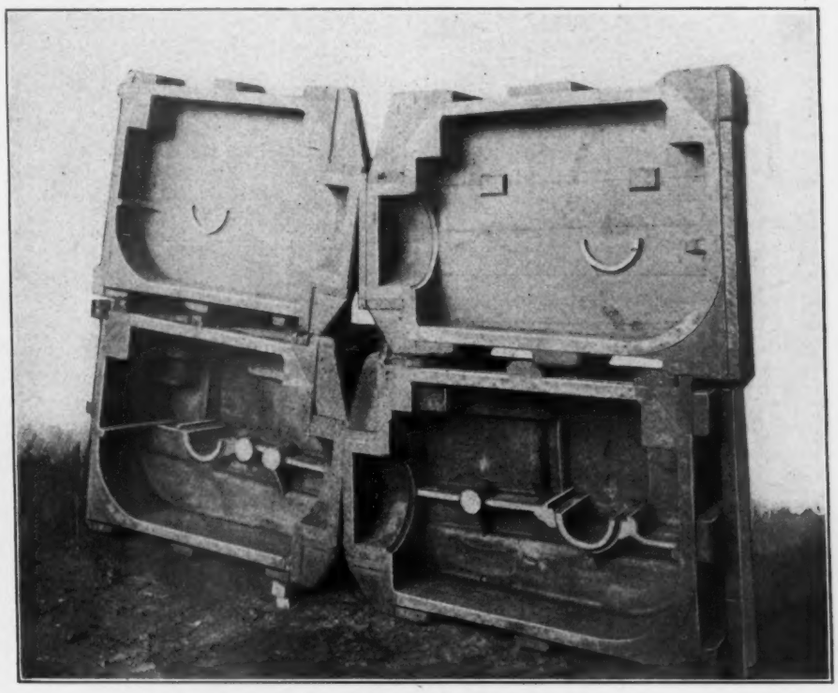


FIG. 2—CORE BOXES FOR CRANK CASE CORE

The molds are oven-dried and by using six flasks, one man and a helper turn out two castings per day. The molds are rammed on a Herman jarring machine equipped with a table 48 inches wide and 72 inches long. The machine is located in the central part of the foundry and the traveling crane is used to handle the flasks. The acutal ramming operations on the jarring machine require less than 10 minutes for each flask, including the time required to move the mold to and from its place on the floor. If the job were rammed by hand, the daily production would be reduced one-half. The patterns are drawn by the aid of a traveling crane.

The two main center cores, shown in the mold, *C*, Fig. 1, were made in halves and were pasted together after being dried. The boxes for the two parts of these cores are shown in Fig. 2. They are of the ordinary construction except that they are metal-faced on all the exposed edges. The core sand is rammed in the boxes by hand. In addition to the large center cores there are six auxiliary cores, making a total of eight to be set in each mold. Each of the heavy cores, of course, is set by the aid of a traveling crane.

The general improvement in the foundry trade has made itself felt in the chaplet business, and recent and pending orders have made it necessary for the Philadelphia Chaplet & Mfg. Co., Wissahickon, Pa., to increase its manufacturing facilities. This company makes its own chaplets and has ordered such machinery as will provide an increase of about 25 per cent in its capacity.

An Easily-Applied Foundry Cost System---III

In This Installment the Operating Accounts Are Analyzed and Forms Are Included for the Plant Record, Daily Cupola Report, Defective Castings Register, Etc.

By O O Brace

IF THE system outlined in this series is to be applied, it must be installed immediately following a physical inventory of the plant, when the books are closed and the profit and loss has been determined. The operating accounts to be opened in the ledger will now be explained in detail, with data on how to determine the amounts to be included in each account, the method of disposing of payrolls and all purchases and expenses. This method provides for the automatic closing of the books and the determination of the profits or losses each month, without a subsequent inventory and without the operation of an expensive perpetual inventory system.

In the accompanying table is an analysis of the various operating accounts required. While at first glance they may appear somewhat numerous, they deal with totals only and usually not more than one or two entries each month will be necessary in any of the accounts and this will require only a very small part of the bookkeeper's time.

Debit the real estate account with the inventoried value of the real estate holdings and any charges are to be made in subsequent entries.

Permanent Plant and Equipment

The permanent account and equipment account includes the totals of the inventory items representing permanent investment in plant and equipment. The total of each individual item may be shown, or at your option it may be carried on a separate card record, or on the inventory books. The distinction must be carefully made between permanent equipment and the temporary shop tools and supplies, such for example as shovels, riddles, bellows, brushes, grinding wheels, chisels, etc. Only those items should be included which represent a capital expenditure as distinguished from articles that are continually wearing out and being replaced. The only addition to this account will come from the closing of the new equipment account, which will be described later. This account should be carried on the books at the original value and a certain amount set up each year in a reserve for depreciation account to cover loss in efficiency and value of plant and tools.

This entire equipment account should be designated by a letter and each class of equipment should be indicated by a number affixed to the account letter. This scheme should be carried out on all records and it is sufficiently flexible to allow any desired grouping or differentiation of the equipment.

Analysis of Operating Accounts

A.—Capital Investments:—
1.—Real estate.
2.—Permanent plant and equipment.
3.—New equipment.

B.—Prepaid Expense Accounts:—
1.—Reserve for interest and discount.
2.—Reserve for depreciation.
3.—Reserve for insurance.
4.—Reserve for taxes.

C.—Stores Accounts:—
1.—Foundry stores.
2.—Core room stores.

D.—Miscellaneous Controlling Accounts:—
1.—Bills payable.
2.—Bills receivable.
3.—Audited vouchers account.
4.—Payroll.

E.—General Burden Account:—

F.—Core Room:—
1.—Coremaking.
2.—Core room burden.

G.—Foundry:—
1.—Molding account.
2.—Burden on tonnage.
3.—Burden on molding.
4.—Manufacturing account.

H.—General:—
1.—Profit and loss.
2.—Surplus.
3.—Capital stock.
4.—Private ledger.

I.—Sales:—
1.—Foundry sales.
2.—Special sales.
3.—Defective and returned castings.

The following is a sample division of the equipment:

m 1.—Buildings.
m 2.—Power plant.
m 3.—Power equipment (line shafts, belts, etc.).
m 4.—Electrical equipment.
m 5.—Machine shop equipment.
m 6.—Pattern shop equipment.
m 7.—Office furniture.
m 8.—Molding machines.
m 9.—General foundry equipment.
m10.—Core room equipment.
m11.—Flasks.
m12.—Patterns.

The new equipment account includes all purchases of equipment or capital expenditures in addition to the equipment already on hand. By this means the expenditures for new equipment are separated from the original investment, the monthly or yearly total of these expenditures is always at hand, and at the end of each fiscal year the total of this account should be transferred to the permanent plant account. Care should be exercised to prevent the inclusion of improper items in this account and all charges thereto should have the written approval of the general manager before being made. Repairs to old machinery or line shafting, for instance, should not be included. Charge to this account only items of actual capital expenditure that constitute entirely an addition to the value and resources of the plant. The same series of numerals should be used to designate charges to this account that are used for the permanent plant account.

Plant Record

If a plant record is not already in existence, it will be highly profitable to inaugurate one. A record of this kind should be indexed under the symbols previously given. The book should be of the loose-leaf type and charges should be entered into it each month for all new equipment. The total values shown by this book should at all times agree with the totals of the permanent and new equipment accounts.

The form shown in Fig. 1 is recommended for the plant record. The description of the new tools should be complete and in the case of large or special equipment, the name of the vendor, his address, serial number, and all information necessary for dispatch in ordering repairs should be entered.

In addition to the cost of the equipment, freight, erection and other expenses incurred in getting the equipment ready for operation should be entered on the plant record, as this is the only way of determining the true value of the equipment when erected. The total of these items will represent the inventory value and these figures should always remain

unchanged in the record, depreciation being handled in a manner hereinafter described.

When the equipment is removed from service, entry should be made in the column shown. The value placed in this column should coincide with the inventory, less the amount which has been allowed for depreciation. When a record is so kept, the difference between the two columns will be the net inventory value.

Prepaid Expenses

Separate accounts for prepaid expenses, reserves for interest, depreciation, taxes and insurance are necessary, although these items of expense are usually incurred annually, or probably semi-annually, and in order to obtain a correct monthly cost statement, it is necessary to apportion them equally over the year's operations.

The method of apportioning these expenses will be explained by a consideration of the insurance premiums which, for example, amount to $600 for the year. Each month, by journal entry, credit the reserve for insurance account and debit the general burden account with $50. When the premium is actually paid charge it to the reserve account. At the end of the year in your last entry, you can correct any slight differences between the sum of your various credits and the amount actually charged into the account. By using care in your monthly credits the difference will be very small.

In opening the interest account, debit it with any amount of prepaid interest shown by the inventory. Thereafter handle it in the regular way, charging it for interest paid by your company or discounts taken by your customers, and credit it with interest which you receive and discounts which you take. Make a monthly charge to the burden account, crediting the reserve.

All permanent equipment including buildings should be depreciated. The rate will depend too largely upon local and business conditions, to attempt to give any definite figures. A new plant, of course, should be depreciated less than an old one. The most satisfactory method is to take each class of equipment and determine, to the best of your ability, the life of the investment represented. Then fix upon a rate of depreciation for that class and adhere to it. Take the total of this depreciation as the amount to go into your reserve account and make your monthly credits and charges in the general burden account accordingly.

Debit the insurance with any prepaid premiums shown by the inventory. Determine the total yearly premiums on the policies carried and credit the account with one-twelfth of this amount monthly, charging general burden.

Follow the same method with the tax account, charging it with any prepaid taxes shown by the inventory, and with the year's taxes when paid. Credit the account with the monthly proportion and charge it to general burden.

Pig Iron STORES SYMBOL A-1

DATE	PURCHASED	USED	BALANCE	DATE	PURCHASED	USED	BALANCE	DATE	PURCHASED	USED	BALANCE
Jan.	Inventory		8961.00								
"	5000.00		13961.00								
"		9000.00	4961.00								
Feb.	8040.00		13001.00								
"		8700.00	4301.00								

FIG. 2—STORES ACCOUNT RECORD, 5 x 8-INCH CARD

The purpose of stores accounts is similar to that of the reserve accounts. They are solely a distributing medium for such purchases as are made in excess of immediate requirements, and hence make items of expense too large to be absorbed by the current month's operations.

Stores Accounts

As an example, the purchase of one or two tons of plumbago, even though a portion of it might be carried over into the ensuing month, would hardly be an expenditure large enough to affect, to any appreciable degree, the current month's costs, or necessitate the opening of a stores account. But if a carload were purchased, as a supply for several months, it would then be desirable to charge the whole into stores account, and to obtain a record of the amount used each month, crediting stores with this amount and charging it to the molders' supplies in foundry burden.

Ordinarily, the following are the only materials purchased in quantities large enough to warrant foundry stores accounts: Pig iron, steel, scrap iron, coke, coal and molding sand.

However, other materials may be purchased in sufficient quantity at times, to warrant opening a stores account for them.

In opening these accounts, go through your stock and pick out the amount of each supply on hand, for

PLANT RECORD ACCOUNT SYMBOL - - - PAGE- - - -

DATE	DESCRIPTION	ITEMIZED COST		INVENTORY VALUE	REMOVAL FROM SERVICE	VALUE
		COST				
		FREIGHT				
		ERECTION				
		EXTRA				
	OUR NO. VOUCHER NO.	TOTAL				
	VENDOR					
	TOTAL (PENCIL ONLY)					

FIG. 1—PLANT RECORD OF PERMANENT EQUIPMENT

which you are to establish a stores account. Enter this as one amount in your ledger as an inventory. Do not record the individual amounts, but fill out a card similar to the form shown in Fig. 2 for each of the items enumerated. Thereafter, charge into foundry stores each month the total of all stores purchased. Also credit foundry stores and charge the proper operating accounts with the amount of material used each month, showing only the total credit in the ledger.

Each month you should enter on the cards the amount purchased of that particular store and credit it with the amount used. Pursuing this system, the individual store cards will always show the amount on hand and these totals must agree with the balance shown on the ledger.

The method of recording the amount of material used monthly, now will be considered. The value of the iron is, of course, of the greatest importance, and will require more care than the other materials. First, an accurate cupola record of the coal and coke charged will be required. Fig. 3 is a good form for this purpose and furnishes other valuable data for your files. These reports are filled out by the man weighing the charges and are turned in each night. To obtain the best results, a binder should be furnished the scaleman, with a supply of blank sheets, and each charge should be marked down as it is weighed. These blanks are filed until the end of the month, when they are to be recapitulated, the values figured and filed away with a monthly index tab attached.

Record of Good Castings

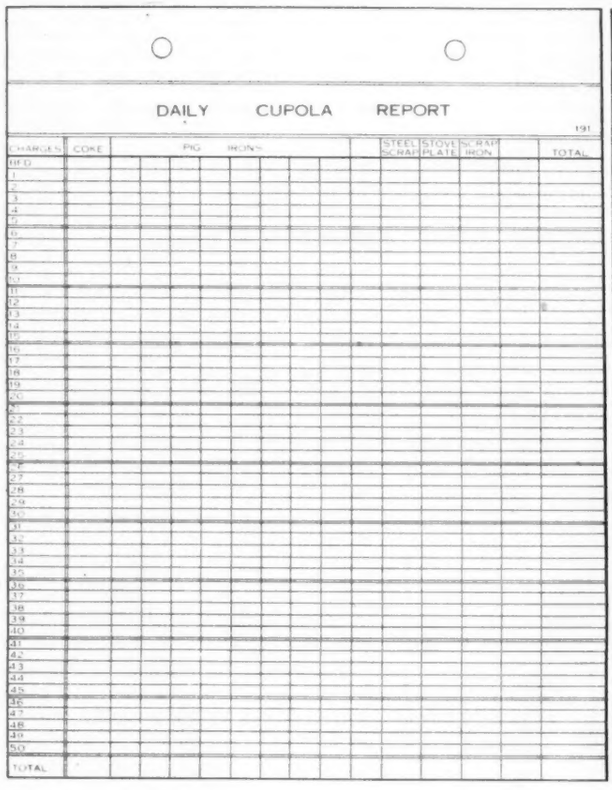
The weight of the good castings will be obtained from the shipping records. This leaves only the weight of the scrap castings, gates and sprues to be obtained in order to have a complete analysis of the iron used each day and of its disposition. The best way to obtain this record is to have the entire foundry output, including gates, sound and defective castings, delivered to the cleaning room and the scrap weighed on its return to the cupola, a record being made daily on a form similar to Fig. 4. The scrap, with the good castings, should total from 92 to 95 per cent of the tonnage melted. If less than this amount is reported the records are inaccurate and the work should be carefully watched until the leak is discovered.

If it is not practical to weigh the scrap each day, approximate results that will be fairly accurate can be obtained by estimating the cupola shrinkage at 8 per cent of the iron charged.

All iron returned to the cupola, after having been melted and charged out of stores, must be charged back into scrap iron stores at the current value of scrap iron.

The yard foreman also should report each day the amount of coke furnished for core and mold drying, etc., and the respective accounts should be charged with this expense each month.

A record of all other foundry stores can easily be obtained without additional clerical expense. In the case of coal, molding sand and similar bulky materials, such as are ordinarily moved in wheelbarrows, obtain a fair average weight of the material moved, place a clip holding a pad of paper in each shed, or bin, and instruct the laborers to enter each load removed. Have these sheets turned in each day and record the amount in any convenient record. These materials are bulky and cheap, hence there is no occasion for splitting hairs. By this method you will have, at the end of the month, a very close record of the materials really used. With smaller stores that are kept in the stock room, have the stockkeeper record the requisitions and report each month


DAILY CUPOLA REPORT

191

CHARGES	COKE	PIG IRONS									STEEL SCRAP	STOVE PLATE	SCRAP IRON		TOTAL
BED															
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
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36															
37															
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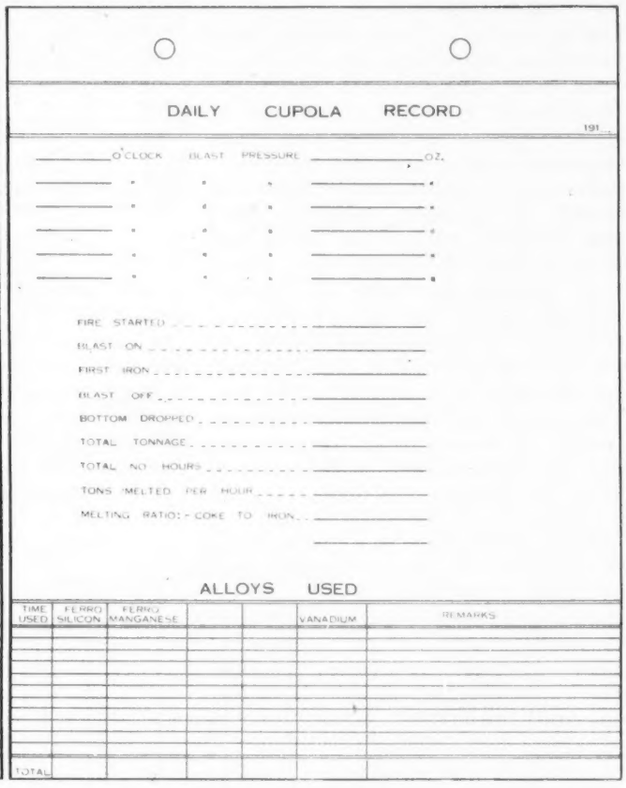
39															
40															
41															
42															
43															
44															
45															
46															
47															
48															
49															
50															
TOTAL															

FIG. 3—OBVERSE SIDE OF DAILY CUPOLA REPORT, 8½ x 11 INCHES


DAILY CUPOLA RECORD

191

_____ O'CLOCK BLAST PRESSURE _____ OZ.

_____ " " " _____ "

_____ " " " _____ "

_____ " " " _____ "

_____ " " " _____ "

_____ " " " _____ "

FIRE STARTED _____

BLAST ON _____

FIRST IRON _____

BLAST OFF _____

BOTTOM DROPPED _____

TOTAL TONNAGE _____

TOTAL NO. HOURS _____

TONS MELTED PER HOUR _____

MELTING RATIO:—COKE TO IRON _____

_____

ALLOYS USED

TIME USED	FERRO SILICON	FERRO MANGANESE			VANADIUM	REMARKS
TOTAL						

FIG. 4—REVERSE SIDE OF DAILY CUPOLA REPORT.

VOUCHER REGISTER — September 191 7

VOUCHER NO.	DATE 1912	CREDIT	OPEN ACCOUNTS	AUDITED VOUCHERS	INDEX	"A" FOUNDRY STORES	"B" CORE ROOM STORES	"C" GENERAL BURDEN	"D" FOUNDRY BURDEN	"E" CORE ROOM BURDEN	"M" NEW EQUIP.	"O" SPECIAL SALES	MISCELLANEOUS NAMES CHARGED	MISCELLANEOUS AMT.
		TOTALS FOR'D.												
1581	9-15	K. B. Co.	650 00		A-1	650 00								
1582	-15	Adams Found. Supls	480 00		D-5B				125 00					
		"			D-15B				70 00					
		"			C-7B			75 00						
		"			B-1		125 00							
		"			M 10						85 00			
1583	-15	La R. Rwy Co		165 00	A-1	140 00								
		"			B-1		25 00							
1584	-16	Adams Supply Co.		125									Speedway Car Co.	
1585	17	Henry Coal Co	500 00		B-4		500 00							
1586	17	Standard Oil Wks	18 76		E-15B					18 75				

FIG. 5—VOUCHER REGISTER, SHOWING MULTIPLE-COLUMN JOURNAL PROPERLY HEADED, WITH ENTRIES. JOURNAL SHOULD BE OF LOOSE-LEAF TYPE

the amount used, checking roughly the balance shown on the store cards with the amount actually on hand.

Core room stores ordinarily will comprise the following items: Core sand, coke (when a special grade is used in the ovens), core oil and wire.

These accounts should be handled in the same manner as the foundry stores accounts for similar stores.

The following series of miscellaneous accounts next will be considered: Bills payable, bills receivable, audited vouchers and payroll.

The first two are found in every ledger and need no explanation. To them are often added accounts payable and accounts receivable.

The account, audited vouchers, is a controlling account to serve as a clearing house for all expense items for which no firm accounts are carried in the purchase ledger. These should comprise chiefly, freight, express and miscellaneous expenses. For reasons explained later, a purchase ledger with an open account for every firm from which you buy, is advised. This audited voucher account will afford a check on the expenses not handled through open accounts. No opening entry is necessary, and the method of making future entries is described in detail elsewhere.

The Payroll Account

The payroll account acts as a check on the accuracy of the payroll disbursements. There should be no opening entry at this time. This account is to be debited from the cash book for all sums paid employes through the payroll and credited each month from the payroll split up with the total amount charged into the various operating accounts. It should, therefore, balance monthly and any failure to do so indicates an error in the disbursements or in the distribution of the payroll charges.

The next series of accounts comprises the following: Capital stock, profit and loss and surplus.

The first should carry as a debit, the total paid-in capital stock, which thus appears on the books as a liability paid to the stockholders.

Into the profit and loss account are posted the monthly profits as shown by the foundry operations. At the end of each fiscal year this account should be transferred to the surplus account, where it remains as undivided profits charged out through losses sustained or dividends paid.

The accounts thus far considered are all either controlling or inactive, as far as appearing on the statement of operating costs is concerned. They serve much as convenient sources of information and afford a check on the accuracy of your real cost accounting as handled through the active operating accounts to follow.

DEFECTIVE CASTINGS REGISTER

DATE	CUSTOMER	VALVES VOUCHER NO.	VALVES TOTAL CREDIT	FOUNDRY STORES	DEFECTIVE LOSS	WEIGHT CLASS 1	WEIGHT CLASS 2	CLASS 8	CLASS 1	CLASS 2	WEIGHT CLASS 7	WEIGHT CLASS 8	WEIGHT TOTAL WEIGHT	MISCELLANEOUS AND RECHARGES

FIG. 6—PROPER COLUMN HEADINGS FOR A VOUCHER REGISTER FOR DEFECTI VE CASTINGS
A multiple-column journal will serve admirably and is much cheaper than a ruled form

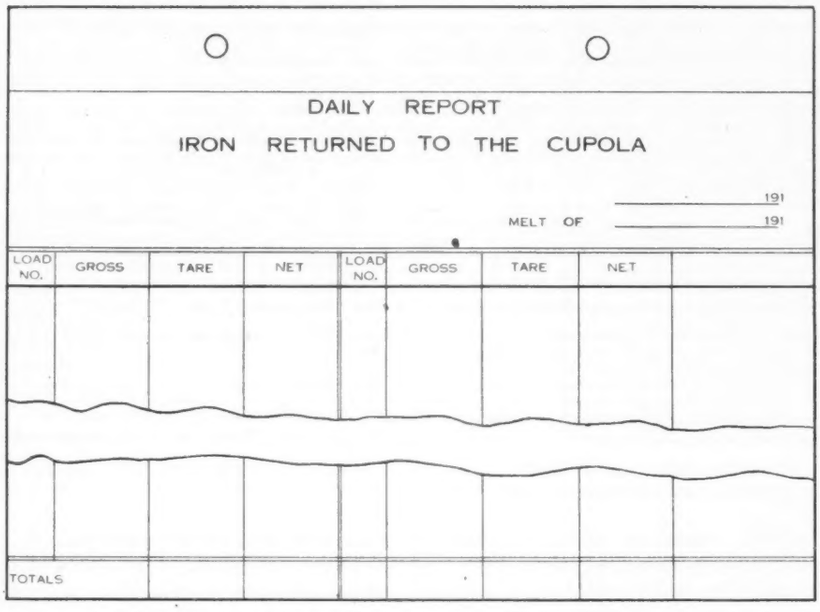


FIG. 7—DAILY REPORT OF IRON RETURNED TO THE CUPOLA. THIS IS TO BE FILED WITH THE CUPOLA REPORT; 8½ x 11 INCHES

To properly analyze the month's expenses it is necessary to pass all invoices and bill through a distributing register. Whether these invoices will be put through individually, as soon as approved, or whether they are attached to a voucher and credited once a month, will depend upon the system that may be desired.

The register is a multiple-column journal and a convenient form is shown in Fig. 5. The totals of all invoices are vouchers, as firms having an open account are placed in the open account column and the items are posted individually. The credits for those with whom no open account is carried are entered in the audited vouchers column and only the total of this column is posted to the credit side of the audited voucher account in the ledger. Similar columns must be kept in the cash book for disbursements.

Accounts Payable

The totals of the open account columns can be posted to a controlling account of that designation, and the balance of this account with that of the audited vouchers account, will always give the amount of accounts payable.

The former, shown in Fig. 5, contains various columns headed foundry stores, core room stores, general burden, foundry burden, core room burden, etc.

On the face of every invoice should be a notation showing to what operating account each of the operations is to be charged.

It will be found convenient to designate each operating account by a letter, and each sub-division of the account with a numeral. Thus, if we designate the foundry stores account with *A*, as sub-divisions we have pig iron, steel, cast scrap, molding sand, etc.; an invoice for pig iron would be designated *A1* on its face, the amount of the invoice entered in the foundry stores column, and the index figures entered in the index column. An invoice for a car of sand, designated *A4*, would also be entered in the foundry stores column and *A4* entered in the index column. At the end of the month, the total of this column will show the total foundry stores purchased, while a reference to the index column will give the amount of each item, pig iron, steel, etc. The same process applies to each of the other operating accounts.

In the next article of this series will be published analysis of the various items under each of these accounts. This sub-division can be expanded or contracted to meet the requirements of any shop.

Credits For Defective Castings

In arranging this voucher record, it will be found desirable to have several extra columns, as they will be found useful, at times, for special information.

At the end of the month, the totals of each operating account are posted to the debit side of that account in the ledger. In this way can be handled an entire month's expense items with a single ledger entry.

A separate register should be kept in which are recorded all credits for defective castings. A multiple-column journal will serve the purpose

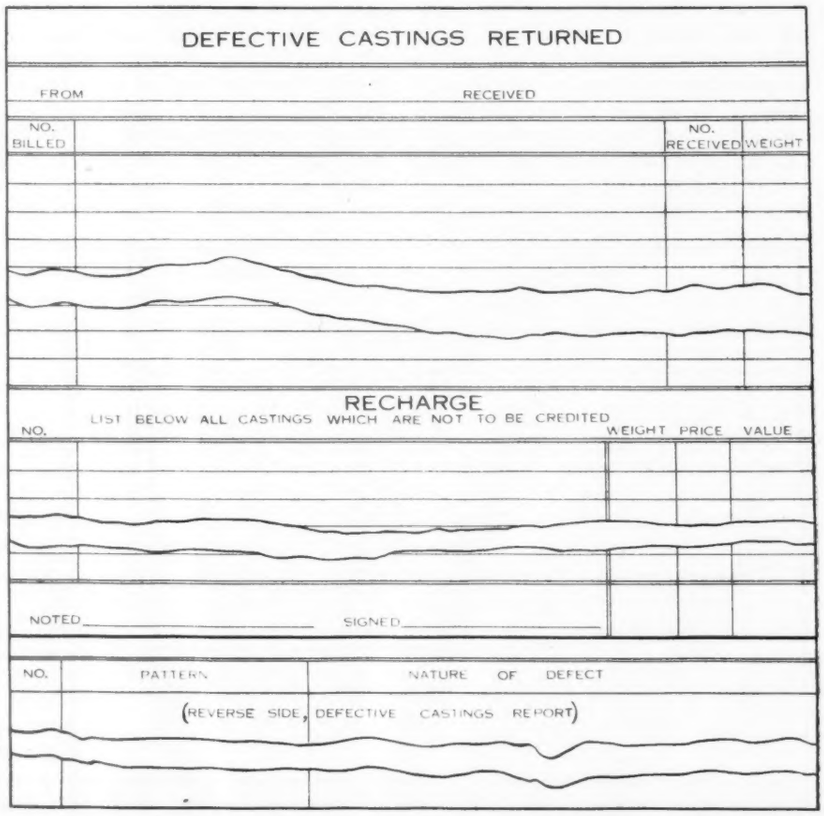


FIG. 8—OBVERSE AND REVERSE SIDES OF DEFECTIVE CASTINGS REPORT

and will require no special ruling. It should have a column for the date, credit voucher number, name of the customer and the amount of credit given. The next column should be headed foundry stores and in it should be entered the value of the scrap iron received when the castings are returned to your shop. In the next column enter the loss sustained, that is, the difference between the amount credited to the customer and the value of the scrap iron received. Of course if the castings were simply scrapped without being returned, the entire amount of the credit is entered in this column. Columns should be provided for each class of castings and in the proper column enter the loss sustained on each class. There should also be columns in which to record the weight of the defective castings in each class. You will require these data in making up the monthly production report.

The credits given are posted to the proper customer's account, and at the end of the month, the total of foundry stores column is debited to foundry stores account, and the total of the next column is debited to the manufacturing account.

Report on Defective Castings

Fig. 6 is a form which has been found advantageous in securing an accurate report on defective castings returned and if utilized insures against credit being given for castings that are not really defective.

The obverse side, Fig. 8, is filled out by the receiving clerk when the castings are received. It is given to the employe charged with the inspection of defective castings, and on the reverse side he makes a report in detail of the defects. If any castings are found to be without defects, that fact is noted and the bookkeeper can make the necessary recharge in the space provided. These reports are filed with the customer's invoice and a complete report is always at hand to prevent disputes.

If the distribution of the molders' and coremakers' time has been kept, the distribution of the rest of the payroll is simple. The easiest method is to group all labor usually employed at kindred tasks, such as cupola men, cleaning room laborers, etc. The timekeeper must note on his daily checking sheets, when any of these men are temporarily transferred to other work. With this information an accurate distribution of the entire payroll is quickly made.

Metal Polishing---Ancient and Modern

By Seymour W Rowsbar

WE HAVE every reason to believe that the specimens of bright steel mirrors, armor and other metal work found in ancient Roman tombs were burnished and that the finish was not obtained by the use of abrasives, such as are employed at the present time. Although polishing, as we now employ the term, is an ancient art and some of the work to be seen in our museums such as the products of the Asiatic artisan is particularly beautiful, we find no reference in the Bible to other than bright or burnished metal and we must conclude that the metallic luster upon all metals was dependent upon the use of a burnisher. The process was necessarily a slow one, especially upon the less noble metals and naturally gave way to the more expeditious method of polishing in use today.

Burnishing

Any rolled, wrought or cast metal presents a surface of projecting particles and by burnishing, brilliance is produced by pressing upon or laying flat the surface of the metal, while polishing produces brilliance by removing the projecting particles. It can readily be appreciated that for work with the precious metals, the burnisher has the preference, as no loss of metal is involved. It is also particularly adapted for relief work in the brass and art metal trades.

Since a varied treatment in hardening, rolling and similar manipulations of various classes of brass, iron and steel is essential, so do they require a varied treatment of polishing and buffing. Every imperfection left on the article after polishing remains in the same state after electro-plating and an article which is indifferently polished cannot be made to appear perfect by any plater, however clever he may be. Every scratch remaining after polishing is reproduced and often magnified after plating. Microscopically, any smooth surface consists of a great number of very fine scratches and in the operation of polishing we replace the irregularities on the surface of a metal by a series of regular scratches, at first somewhat pronounced. These scratches are then substituted by series of finer scratches, the finest of all constituting the finished, polished surface. The chief points in polishing are, therefore, the material to be applied and the medium and method of application.

Emery, the abrasive in more general use for polishing, is a minerai of comparatively rare occurrence and mysterious origin. Data as to its discovery as an abrasive are not available, but its utility to the industrial world has gradually increased until now thousands of tons are annually used for this purpose. No doubt the increased production of iron and steel, together with the development of power, which renders the employment of high-speed rotary tools possible, is responsible in no small measure for the increased consumption. Emery usually consists of alumina, 82 per cent; oxide of iron, 10 per cent; silica, 6 per cent, and lime 1½ to 2 per cent. It is found in many localities, but the best grade comes from the Grecian archipelago and always has a granular structure. It is of the same mineral species of which corundum and sapphire are also varities and agree perfectly with them in composition, hardness and specific gravity, but is dull opaque and not crystallized. The various sizes are obtained and numbered according to the meshes of the sieve used in sifting after stamping. Corundum is of a similar formation to emery, but somewhat harder. The operation of polishing removes but a small amount of the metal and, therefore, there is but little danger of interfering with the temper of the article. Any material used as an abrasive should not be hard in the sense that it will not break.

Polishing

A properly set-up polishing wheel is simply a continuous file of irregular teeth, yet of even cut, but with the following difference. The teeth of a well-cut file, when new, present sharply-defined, acute angles to the work and when the extreme joints are worn away, acute angles are still presented, although the top of the teeth are flat When the sharp points which constitute the cutting edge of emery become worn, the emery should break into more fresh points, otherwise an obtuse angle without any cutting power would remain

and the effect would be merely to scratch the work.

In setting-up a wooden wheel, the operator should attend closely to the condition of the glue, as well as the wheel and emery. A good wheel cannot be made with glue so thick that it leaves a string of glue a yard in length when removing the brush. Much of the trouble and guesswork in the handling of glue may be avoided by the use of a glue thermometer. These little instruments are probably the best paying investment, according to cost, in the entire polishing equipment and save their cost many times over in a year by preventing the expense arising from using glue at improper temperatures. The emery should be firmly imbedded in the glue and any glue applied too thick will not allow the emery to become properly seated. Moreover, it will not admit a sufficient quantity of emery particles to build up a compact and solid mass. Particles of the emery not only support each other, but there will be so little glue unattached that none of it can be seen at the surface.

The glue should not be allowed to boil. At the boiling point glue deteriorates and as boiling water is injurious to animal matter, such as leather, with which the wheel is covered, it must damage the surface of the wheel. Use the glue hot and liquid, but avoid boiling. Compressed polishing wheels are particularly economical in the use of both emery and glue, as the end grain of the fabric or leather is presented and the glue gets a firmer hold than on the flat side of the material and lasts longer. Compressed wheels are being used with less than one-half the emery and glue formerly required for other styles.

Not many polishers warm the wheels before applying the glue. Regardless of the condition of the glue, all the advantage will be neutralized if the wheel itself is cold, as the glue will be chilled and will lose its power of penetration into the material. The emery also is usually applied cold and is kept in wooden troughs, yet it should be at least as warm or even at a higher temperature than the glue. If the emery is colder than the glue, only the points of the crystals are caught and the glue is immediately chilled Condensation takes place and bubbles of gas are formed around the particles of emery. When this occurs, regardless of the pressure on the wheel into the bulk of emery, the particles are not held in that rigid manner which is necessary to insure long life to a polishing wheel.

A cast iron trough with a steam coil or a small Bunsen burner underneath it, will suffice to maintain the proper temperature of the emery. In setting-up a finely dressed wheel for greasing or glazing, the greasy matter finds its way to the leather or felt and the adhesive powers of the glue used in the next dressing is greatly reduced. To prevent failure of the glue, a small amount of powdered Vienna lime should be rubbed on the surface of the wheel before redressing.

The speed of polishing lathes is a problem which requires more attention than is often given to this subject. No hard and fast rule can be laid down for the speed of polishing wheels on account of the great variety of work, the differences in the character of glues and the hardness of abrasive material, but it may be taken as rule, that for effective work, the minimum speed should be equal to 4,000 surface feet per minute. The speed will be limited by the melting point of the glue, which varies in different glues, also by the hardness of the emery.

Polishers often entertain the idea that the center portions of felt wheels contain an inferior material and to substantiate this contention, they produce work on the wheel when new which is superior to work finished on the reduced wheel. Nevertheless, the wheel or material is rarely at fault, and almost invariably the surface speed of the wheel has been wrong. To illustrate: Take a 15-inch wheel and use it on the same spindle at the same speed until it is reduced to a diameter of 8 inches, when the speed will be too low to be effective. For this reason it is a good idea to have one or more lathes running at high speed in order to obtain the full efficiency from reduced sizes of wheels.

Hard, sharp emery naturally can be run at greater speeds than softer grades which will soon crush and glaze. High speeds are more generally employed for ordinary polishing than for coloring work with emery, a softer grade of emery being preferable for the latter. Carborundum is now being extensively employed in polishing and is an excellent material when properly applied and intelligently employed.

Electroplating Costs by the Square Foot

ESTIMATING the cost of electroplating is extremely difficult as conditions are seldom the same on various classes of work. However, we have determined in practice that with a 300-gallon bath of acid copper solution and an anode surface equal to, or in excess of the cathode surface, the solution containing 1½ pounds of copper sulphate and 2 ounces of sulphuric acid per gallon and employing 10 amperes of current per square foot of cathode surface, 11.9 grams of copper per square foot is deposited, or 1 pound of copper would be deposited on 1 square foot in 38½ hours. Allowing 6 gallons of copper solution per square foot, a 300-gallon bath would accommodate 50 square feet and receive a deposit of slightly over 1¼ pounds of copper per hour. Thus, with copper at 18 cents per pound, 22½ cents worth of copper covers 50 square feet of surface with a deposit of about 0.0005 inch in thickness. To maintain the bath in good working order, about 12½ pounds of copper sulphate per day are required at a cost of 75 cents. The cost of labor at 30 cents per hour equals $3 per day, and the total cost of material and labor, about $6.

By employing 30 amperes per square foot, the deposit would be 0.0015 inch in thickness per hour, the only appreciable increase in cost being the value of copper and an agitating apparatus. Approximate cost of a deposit of 0.0005 inch would be about 1.20 cents per square foot and for a deposit of 0.0015 inch, or three times the former, the cost would be about 2.10 cents per square foot. To these figures must be added overhead expenses and incidentals, such as cleaning, drying, etc. In reference to polishing and buffing, the cost varies with the finish desired, but in arriving at the following estimate, the work was merely roughed on No. 70 emery, then coppered and buffed with sewed buff. These operations consume approximately 5 horsepower, which, at 3 cents per horsepower per hour, equals $1.50 per day. A polisher's time at $3 per day totals $4.50 or one polisher equals 5 square feet per hour at a cost of 9 cents per square foot, to which must be added such incidentals as glue, wheels and emery, as well as overhead expenses, while the buffing would total approximately one-third the polishing cost or 3 cents per square foot.

Summarizing the approximate costs,

the total is 13.2 cents per square foot and 14.1 cents per square foot for the finished article independent of incidentals and overhead expenses. If lacquering is required the man-hour rate should be not less than 20 cents. These figures are based on sheet iron work of plain design, coated with copper in an alkaline copper bath prior to placing in the acid copper solution, this operation being necessary as the acid copper solution attacks the iron. For the maintenance and operation of a small bath for this work, add about $1 per day to the total costs. Work consisting of irregularly-shaped pieces would entail a greater expense in polishing and finishing.

Ascertaining the costs of plating and finishing has proven to be so difficult and varies so greatly, that in most large shops the cost experts treat these operations as special in distributing expense, or dispose of the plating as a rate per man-hour, the expense of the department divided by the number of man-hours worked giving the rate. The estimates are merely approximate and under certain conditions could be lowered while the costs would be considerably greater on smaller quantities. There are many firms throughout the country who charge from 75 cents to $1 per man-hour for plating or polishing, but as far as we are aware, none has obtained a satisfactory figure on the square foot plan.

DIFFICULTIES OF THE PLATER

The Reason Why and the Remedy

Cleaning Aluminum

We would like to have the formula for a solution which can be used for cleaning aluminum castings which have tarnished after they have been polished.

There is no solution that will restore the luster to tarnished, polished aluminum surfaces. Any preparation which will remove the oxide also attacks the metal to such an extent that the surface is rendered dull. Stains or other discolorations may be removed by immersing the aluminum in a solution of caustic soda, 8 ounces, and water, 1 gallon. After immersion for a few seconds, the aluminum castings should be rinsed in cold water. This solution produces an oxide of aluminum upon the surface, which is then removed by a momentary immersion in a solution of nitric acid (38 per cent), 4 quarts, and oil of vitriol (66 per cent), 1 quart. A white surface is then produced, which is clean, but lacks luster. Buffing the polished surface is the only method known today for producing a luster upon aluminum, which would be practical to use commercially.

Plating Shot

Kindly advise us whether the sample of shot submitted has been dipped, and if so, what kind of a solution has been used? What type of basket should be employed to hold such small pieces? Also we would like to fill the letters on a name plate in black. We have tried many different methods without success.

The shot alloy undoubtedly received its color by oxidation in cooling from a molten condition by contact with clean, cold water. In our efforts to prove this by experiments, we found the quantity melted too small to pour successfully and we were obliged to resort to an acid dip to obtain clean shot. The dip used consisted of one gallon of nitric and one gallon of sulphuric acid. The pieces were rinsed immediately in clean, cold water and were dried in boxwood sawdust. They were then allowed to remain exposed to the air for 48 hours, when the color was found to resemble the sample closely. Five pieces of the alloy were recolored as follows: A saturated solution of caustic soda and sulphate of copper was prepared and one part of the sulphate of copper solution and one-half part of the caustic soda solution were mixed with five parts of water, heated to the boiling point. The alloy then was immersed 5 to 10 minutes and was rinsed in clean, cold water, being dried by a centrifugal dryer. Next, the alloy was exposed to the air and strong daylight for a day or so and the desired color was obtained. A small piece of alum dissolved in nitric and sulphuric acid also proved quite successful. The color deepened in 24 hours.

A fine mesh copper or aluminum basket should be used if dipping is resorted to, and the alloy can be dried by a centrifugal machine. If poured clean, no solution should be required.

The method generally employed for filling-in letters on name plates is to lacquer or japan the entire surface and then to remove the coloring material, when dried, with a polishing wheel and fine emery or tripoli. The plate is then colored on a felt buff. The lacquer may be applied by hand by dipping or spraying and is removed easily by the method outlined. This is the most expeditious method that can be found and is the least expensive.

Frosted White Finish

How should we proceed to produce a frosted white silver finish on brass novelty goods without an electric current? The process must be cheap.

The finish you desire is commonly known as the satin silver dip finish, and is obtained by first cleaning the brass with either potash or lye and producing a satin finish on the brass by immersing it in an acid mixture or by sand blast. For your purpose, the acid satin finish would be preferable. The dip is composed of oil of vitriol, 2 pints; nitric acid, 1 pint; muriatic acid, ½ pint, and water, 2½ quarts. If the matte or satin finish is too coarse, add more oil of vitriol. If too fine, add more nitric acid. The dip works more rapidly if used warm. After removing the work from the satin finish brass dip, and rinsing, pass the articles through a bright acid dip consisting of oil of vitriol, 1 gallon; nitric acid, 1 gallon, and ½ ounce of muriatic acid. Dip the work dry into this solution and avoid introducing water into the solution, as by so doing it would soon be converted into a satin finish dip. The brass may be strung on copper wire or placed in a dipping basket of aluminum or stoneware. When bright, the articles are well rinsed and immersed in the silver dip consisting of nitrate of silver, 1 ounce; potassium cyanide, 6 ounces; caustic soda, 10 ounces, and water, 2 gallons. Keep the work in motion while in the solution. Remove and allow the solution to drain off and rinse in clean, cold water. Dry the work by passing it through boiling water and the use of clean, fine maple or boxwood sawdust. Keep the silver dip at a temperature of at least 120 degrees Fahr.

Gray Iron Mouth-Piece Casting for a Retort

A Discussion of the Molding Difficulties Involved in Making This Section and How They Were Overcome

By Pat Molder

THE MOUTH-PIECE casting for a retort, shown in Fig. 1, is made with the branch pipe, *A*, set at different angles on different castings. The outline of the trunk of the main casting, with the flanges removed, is illustrated in Fig. 3, in which it will be noted that it is dome-shaped in cross-section. The assembled pattern, as shown in Fig. 1, is parted on a vertical line. This parting was necessary in order to make the draw when an ordinary three-part flask was used. The core was made in two sections, each being set separately. This made it difficult to get the same thickness of metal on all sides of the casting, as only 5/8 inch of metal thickness had been allowed.

The trouble in making this job is greatly increased by the necessity of having the branch section, *A*, set at different angles on different castings. Otherwise, a core print could be provided and a core box made so that a dry sand core could be used above the branch, *A*, and the necessity of the drawback obviated. Of course such core boxes and core prints might be provided for setting the connection, *A*, at all the different angles required, but it probably would not be advisable, as so many core boxes, and pattern parts would be confusing to the molder.

Another, and the the writer believes a better way of making the same piece, would be to have the main pattern solid. A flask, as shown in Fig. 2, would be used, in which the cheek is cut on the line *A A*. This line follows the shoulder of the main casting as illustrated in Fig. 1.

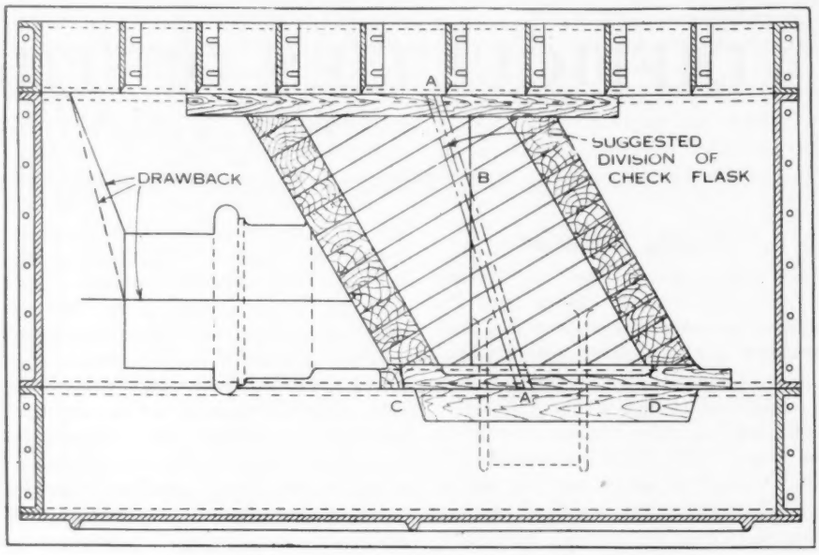


FIG. 2—SPECIAL FLASK FOR RETORT MOUTH PIECE

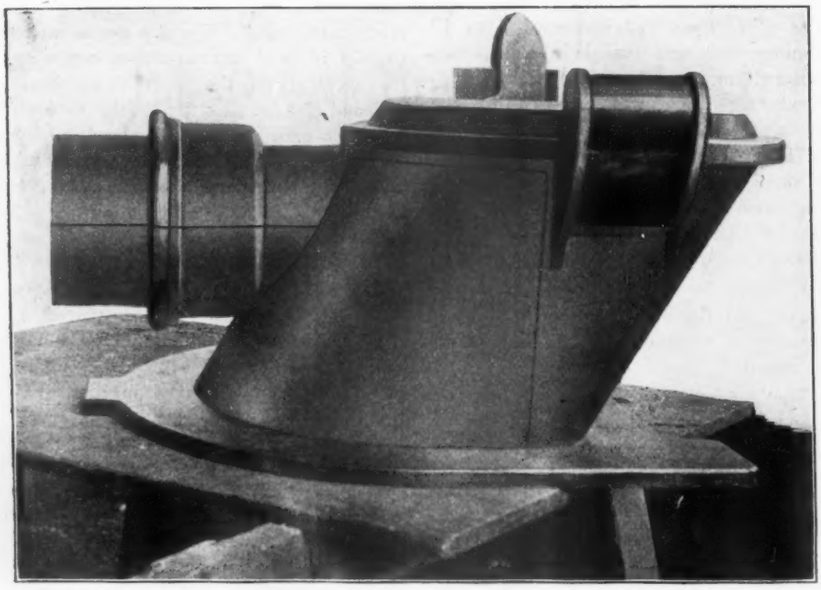


FIG. 1—ASSEMBLED PATTERN OF RETORT MOUTH-PIECE

If this method of molding were adopted the steps would be as follows:

The lower flange, *B*, Fig. 2, which would be loose from the main pattern, would be rammed in the drag, and the main pattern, together with the branch pipe, *A*, Fig. 1, would be set in the cheek. Pieces would be provided which would clamp along the cut, *A A*, in the cheek, and these would fit snugly against each side of the main pattern. These pieces would facilitate ramming. A green sand core set above the branch pipe would permit the withdrawal of the branch, and by having the piece, *C*, loose, nothing would interfere in drawing the main pattern.

For ease in making the core, the core box could be parted and the core made in halves. These halves could be pasted together before setting in the mold, the entire core being set at one time, thus insuring a more uniform thickness of metal throughout.

As the peculiar cross-section of the main casting does not give the same intersection with the branch pipe, *A*, when the branch is set at different angles, some mechanical means of locating it in each required position is of great assistance. A method for accomplishing this is shown in Fig. 4.

A rough board having a hole cut in

the center large enough to take the main part of the pattern is built-up and the pattern is set in as illustrated. The branch section is then laid on this board at the required angle and its intersection with the main casting is obtained. This eliminates a great deal of drawing on the part of the patternmaker and the same board is a great help to the molder in subsequently setting the pattern in the mold. This device would be applicable to many other patterns in which it is difficult to develop the correct figure of the intersection between two irregular pieces.

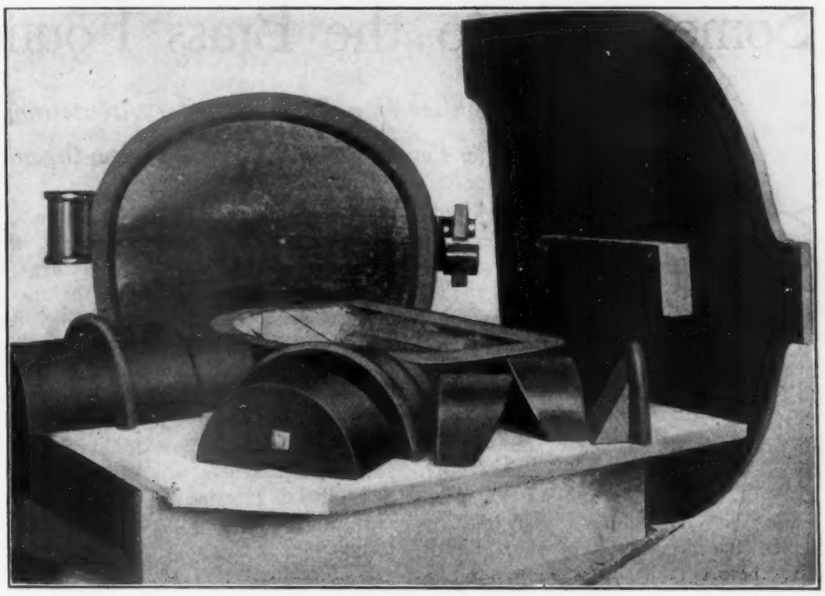


FIG. 4—GETTING INTERSECTION OF BRANCH WITH MAIN BODY

Interchangeable Street Sign Patterns

The foundry of the Minneapolis Steel & Machinery Co., Minneapolis, recently received an order for a large number of cast iron street signs. To handle the job economically, it was necessary to devise a pattern which could be used on a molding machine, but which at the same time would permit the lettering on the signs to be changed readily. To accomplish this the device shown in the accompanying illustration was adopted. It consists of a bottom board, 20 x 26 inches, provided with flask pins and arranged so that it can be clamped to the table of a Pridmore roll-over molding machine.

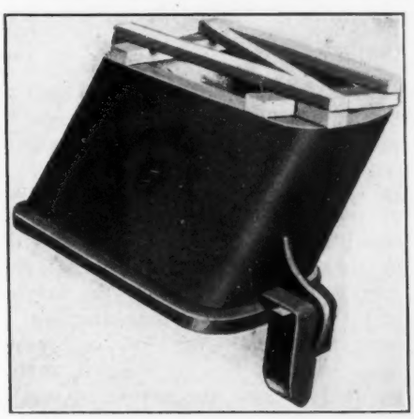


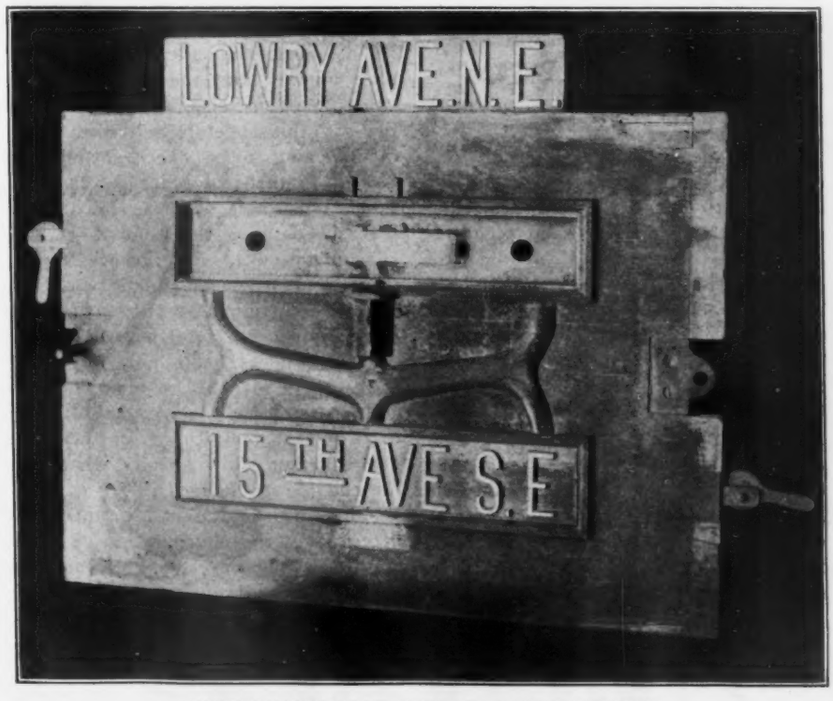
FIG. 3—PATTERN WITH FLANGES REMOVED

The sign plates are 23 inches long and 5 inches wide with the lettering on both sides. The patterns are wood of a similar size, the letters being fixed to the base board by small brads. The patterns are mounted on the large bottom board in the manner indicated in the illustration and are held in place by movable panels operated by two small eccentric clamps. The metal is led to the molds by the gate shown between the patterns. There is a flat spring under each of the removable pattern plates to prevent their sticking. When the lettering on the signs is to be changed, it is only necessary to remove the old plate and to substitute a new one. Since the signs are lettered on both sides, the cope and drag sides of the casting are symmetrical and the pattern plates may be used interchangeably. The production obtained with the aid of this device is 40 flasks per day per man, each containing two name plates.

The Hawley Down Draft Furnace Co., Easton, Pa., recently made a shipment of a carload of melting furnaces to Australia. Other foreign shipments made during February include a large furnace to Manchester, Eng., and one for the government at New Zealand.

Aluminum Solder

Richard Seifert, Union Hill, N. J., has received a patent on a new aluminum solder, which consists of tin, 38 per cent; phosphor tin, 32 per cent, and zinc, 30 per cent. After melting and mixing, this solder is used with 20 per cent of its weight of rosin, which acts as a flux. It is claimed that not only can aluminum be soldered to aluminum by this mixture, but to other metals also.



INTERCHANGEABLE STREET SIGN PATTERNS

Some Aids to the Brass Foundry Management

The System of a Large Shop for Ascertaining Metal Losses, Cost Per Pound, Etc., With Side Lights on Organization Efficiency

AT THE March meeting of the Pittsburgh Foundrymen's Association, W. M. Corse, secretary of the American Institute of Metals and works manager of the Lumen Bearing Co., Buffalo, presented a paper entitled "Some Aids to Scientific Management in the Foundry". Because of the broad scope of his topic, the speaker confined his discussion to that of costs. Mr. Corse said that his subject was suggested by the address delivered by A. O. Backert, editor of THE FOUNDRY, before this association at its February meeting. "Estimating the Selling Price of Castings" was the topic discussed by Mr. Backert, who pointed out the lack of system among foundrymen in arriving at profit-making prices for their output.

Mr. Corse's address follows:

"One of the first steps in the scientific management of a plant, is to plan a proper organization. This gives everyone a base from which to start and clarifies the atmosphere of petty jealousies and misunderstandings. A system of factory records is next established so that the management may have written information of the current shop operations and a record for the future. These records may consist of daily, weekly or monthly reports and should serve to furnish information that will give a mental picture of affairs in a concise manner.

Metal Report

"I will describe some of the records which I have used successfully in a brass foundry. The first and most difficult report to keep accurately, is that of the metal melted and of the output. We may call it the metal report or practice sheet. To secure positive results it is advisable to have a separate room in which to store the daily supply of metal for the various mixtures and the shop scrap from each alloy produced. This material should be kept in separate bins or boxes, properly marked with the alloy number, so that errors in weighing can be minimized. As many alloys are similar in color, great care should be exercised in delivering the castings from the foundry to the cleaning room and in removing the gates, risers and defective castings from the cleaning and inspection departments. In this case, as in all movements of goods in process, the arrangement of the various departments should be such that the metal moves in a direction that does not cross or back-track other metal. The tagging of alloys that cannot be readily picked out by their appearance will aid materially in keeping this record accurate. A jobbing brass foundry frequently will have 25 standard alloys, as well as a large number of special mixtures in a day's output.

Handling Metal

"The successive steps in handling the metal will be considered. The storekeeper weighs out the bulk metals to the foundry metal room, receiving in return a signed requisition from the weighmaster. This requisition serves as a check on the store records and aids the purchasing department in balancing the materials account with the accounting department at the end of the month. Next, the weighmaster weighs out the various amounts of new metals and shop scrap for the mixtures ordered by the furnace department, using the daily working formulae given to him by the metallurgist in charge of the laboratory. Before delivering the mixtures to the furnace department, the weighmaster should record on a special ruled sheet, the alloy number, furnace number and the weights of the constituent metals. At the end of the day this sheet is delivered to the metallurgist to be checked and then is sent to the cost office for compilation. The totals of these daily sheets for a week give the amount of each alloy charged to the furnace department and when credited with the amount remaining at the end of the week, shows the metal melted for that period. These sheets not only show the amount of the various constituents used in each alloy, but also the total of each metal used for the week. They further show exactly what each furnace is producing.

"This information can be used for determining the consumption of metal and gives the purchasing department an accurate figure on which to base future purchases for the maintenance of a sufficient stock for the orders on hand. It would hardly seem necessary to direct attention to this record, but I have often been surprised to find that no such information is available in many large foundries.

"We now have figures on our weekly summary sheet which may be said to constitute the debit side of the account. The credit side of the account consists of the output of the foundry, divided into ingot metal, good castings, bad castings, gates, risers and recovered metal. They are weighed by the inspection department, the first three coming from the inspection department itself, the fourth from the cleaning room, and the fifth from the recovery department. They are separated first by a day's work, then by alloys. Subtracting the output of each alloy from the metal charged to the furnace department, will give the gross loss of each mixture and the difference of the totals the gross loss of the foundry for the week.

Recovered Metal

"The net loss is figured at the end of any period by assaying recovered metal too fine to be returned direct to the foundry, from the metal recovery department, figuring the weight of metal recovered and subtracting it from the gross loss. For cost purposes, the net loss by weight cannot be used because the recovered metal cannot be sold for its full value to the smelter. Therefore, we estimate the value of the metal melted for the period in question, divide it into the amount received from the smelter for the recovered metal, thus arriving at the percentage of the recovered metal. This is subtracted from the gross percentage loss to be added to the formula cost of the alloy. This is not strictly accurate in that the gross percentage loss by weight may not represent the formula cost of the new metal, but as the more volatile metals are usually the cheaper, the error is on the safe side. For example, the new metal may consist of 85 parts copper, 5 parts tin, 5 parts lead and 5 parts zinc. This would cost on the basis of 50-cent tin, 4½-cent lead, 15-cent copper and 7-cent zinc, about 15.82 cents a pound. If we are making ingot metal, we would add the approximate net loss of 3 per cent, determined as outlined above, or 0.47 cent to 15.82 cents, giving us 16.29

cents as the cost of the metals constituting the alloy.

"The fact that such a figure does not give the cost of the alloy in the castings is frequently overlooked in cost accounting. Let us see why this figure cannot be used in estimating the cost of castings. If we melt 100 pounds of metal, we may assume, in ordinary brass foundry practice, that we shall net about 45 pounds of good castings. It is apparent that 100 pounds of metal in the mixture costs 15.82 cents per pound and that we lose 3 pounds valued at 0.47 cent per pound. Therefore, 45 pounds of good castings would cost 45×15.82, or $7.13. Figuring the loss on the value of the good castings we get $0.47 \div 7.13$, or 6.6 per cent. The metal in the castings, therefore, costs 106.6×15.82, or $15.82 + 1.04 = 16.86$ cents per pound. An easy way to determine the amount to be added for loss is to divide 100 by the percentage of good castings produced, in this case 45 per cent, giving a factor of 2.2. Multiplying the net loss of 3 per cent by the factor 2.2 we get 6.6 per cent, which is the same as we determined by the other method. We have now found, by the use of the metal report or metal practice sheet, a means of checking the store records, the amount of metal melted, the output and the factors to be used in figuring the value of the metal for cost purposes.

Daily Casting Report

"The second record of importance is the daily casting report. The first essential for this report is to have every day's work kept absolutely separate in all departments handling the castings, except the shipping room. There are many advantages in keeping the day's work separate, which pay for the extra labor involved. As soon as the castings are shaken-out they are checked for count and customer's name by the foundry clerk and are delivered to the cleaning room. This record is made in duplicate and a copy is sent to the production clerk, who records the number of pieces made on the shop order, which is a copy of the customer's original order. This, in turn, enables the production department to keep in close touch with the orders in process. When the castings are received from the cleaning room, they are examined in the inspection department and the weight and count of good and bad pieces are noted. The good castings pass directly to the shipping department, while the defective pieces are sorted by pattern and molders' numbers on a bench set apart for the purpose. When the day's work has been inspected, the foundry superintendent and factory engineer go over each lot of defectives and note the causes of the defects. This serves to furnish information for the immediate correction of excessive losses.

Defective Castings

"We all know that one of the big leaks in any foundry is the amount of bad castings, so that the relatively small amount of time spent in their examination will surely lead to large savings. It is surprising how frequently this examination is casual, instead of systematic and it generally needs a cost record to emphasize the amount of the loss through defective castings before much attention is paid to this feature. A bonus paid to the foremen when the percentage of defectives drops below a stated amount, will often stimulate his interest. The inspection department records the number and weight of the good and bad pieces opposite the count noted by the foundry clerk on the daily casting report and the percentage of defectives, by pieces, is calculated. This report is arranged by molder's number so that it will show the foundry superintendent and factory engineer the quality of work being turned out by each molder. A compilation of the daily reports for the week will show the percentage of loss by each molder, and the weight of castings produced. The latter, when divided by the number of working hours, will show the pounds produced per molder per day for the week. This serves as an excellent check on each molder's efficiency. Another compilation will show the total castings produced per alloy by weight and pieces and also the total weight and pieces for the week. This is the source of part of the information regarding output which was mentioned under metal report. From the total weight and pieces is figured the average weight of the castings produced and the total defective loss in percentage by weight and pieces. This gives a good general idea of the efficiency of the foundry department when taken in connection with average pounds produced per molder per day.

"A careful study of the reports described will give a good general view of the conditions in the foundry. The results may be plotted on a graphic chart which will show these conditions at a glance more effectively than a report consisting of figures only.

"When a job is of sufficient length to make it advisable, the record of the defectives may be kept on cards arranged by pattern numbers. The average of a period points out the excessive defectives and indicates the patterns to be improved immediately, in order to gain maximum benefits.

"The third set of records consists of individual cards showing the exact time spent on each job. On these cards are entered the weight and count taken from the daily casting reports, thus giving a complete record of the job to be used as a basis for figuring its cost. The various items of expense chargeable to each job are taken from the expense analysis of the month preceding. This expense analysis is made up from the payroll, which has been subdivided by job or standing plant order numbers, and the various items of expense are taken from the storeroom requisitions and the voucher register in the accounting department.

"To summarize, we have the sources of information for the three items of cost, namely: Material, labor and expense.

"First.—The metal report, which gives the cost of material.

"Second.—The individual cost cards, which give the labor on each job.

"Third.—The expense analysis, which gives the items of expense chargeable to each hour of productive labor or each pound of castings produced, depending on which method is followed in figuring the expense in the department in question.

In Conclusion

"To scientifically manage any business, the basic facts which underlie it must be known. As a step in this direction, the reports mentioned will serve to give fairly complete information. Many others can be added to give specific information, such as figuring piecework rates and standard time and bonus rates, but these should, in my opinion, follow those first mentioned.

"I have tried to outline the use to be made of a few principal reports with a view of stimulating interest in securing accurate information. It is only by this means, I believe, that the so-called scientific management can be introduced in a foundry. After a year or two the more complex methods of pay and performance can be added, but I think the mistake may be made by trying to introduce too much at first, thus causing confusion and distrust on the part of all who should reap the most benefit from a perfected system of cost and efficiency."

The Royal Ventilator Co., Philadelphia, is installing six large ventilators in the new foundry of the Bridgeport Iron & Steel Works, Bridgeport, Conn.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

High Compression Bronze

Can you furnish us with a bronze bearing mixture that will withstand a 100,000-pound compression test on a 1-inch cube without taking a permanent set of more than ⅛ inch?

You will find that the following mixture will answer your requirements: Copper, 80 per cent; tin, 19.75 per cent, and phosphorus, 0.25 per cent.

Non-Corrosive Bronze

We would like to have a good brass or bronze mixture that will withstand salt water corrosion.

The following alloy will be found to be an excellent bronze for the purpose mentioned: Copper, 87 per cent; tin, 4 per cent; phosphor tin, 4 per cent, and lead, 5 per cent. A brass mixture that can be used for the same purpose consists of copper, 67¾ pounds; zinc, 26 pounds; tin, 3 pounds; lead, 3 pounds, and manganese-copper, ¼ pound. First melt the copper under charcoal, then add the manganese-copper and stir thoroughly. Superheat the copper five minutes, then add the zinc gradually, followed by the lead and tin. Do not pour too cool and keep the heads full of metal while casting the molds.

Lead in Plumbers' Brass

We manufacture castings for plumbers' brass goods and use from ½ to 2 ounces of aluminum to 100 pounds of metal. One of our customers claims that the aluminum makes it difficult to machine the casting. Our mixture consists of brass turnings and brass rods. Is there any reason why aluminum should not be added to a brass mixture? Does it affect the machining properties of the brass in any way?

The addition of 3 per cent lead to this mixture will remedy this trouble.

Porous Castings

We recently made a cylindrical casting, 18 inches long, 7 inches outside, and 6 inches inside diameter, poured on end, which was exceedingly porous. The mixture we used, follows: Scrap brass, 40 pounds; ingot copper, 27 pounds; tin, 4 pounds; lead, 4½ pounds, and 15 per cent phosphor-copper, 1½ pounds. The brass and copper were melted in a coke furnace and after the crucible was removed the tin, phosphor-copper and lead were added in the order named. The pot was permitted to stand for a short time to cool the metal. What process is employed in melting copper under charcoal?

It is difficult to reply to this inquiry without a knowledge of the character of the scrap brass used. If the latter was red brass, too much tin and lead were added to make a good mixture. This, however, would not cause porosity. If the scrap was dirty or contained a large amount of oxide, porous castings might be produced in spite of the phosphor-copper used. If the scrap is red brass, charge the brass and copper together, add a pound of charcoal, melt, add the phosphor-copper, and then the tin and lead. Use 2 pounds of tin and 3 pounds of lead. If the scrap is yellow brass, melt 27 pounds of copper with charcoal and when the copper is molten, charge the brass in small installments so as not to chill the copper. When the brass and copper are molten, stir well and add the tin and lead. In this case, do not use phosphor-copper.

Porous Brass Urns

We would like to have a bronze mixture suitable for urns. We are casting these in different sizes from 4 inches in diameter and 6 inches high to 14 inches in diameter and 18 inches high, the metal thickness varying from ⅛ inch to 3-16 inch. The castings are exceedingly porous. We have tried different grades of molding sand, from fairly heavy loam to exceedingly sharp sand and yet our casting losses average as high as 40 per cent.

The following alloy should prove satisfactory: Copper, 88.5 per cent; tin, 5.5 per cent; zinc, 3.5 per cent, and lead, 2.5 per cent.

Another mixture, which is standard for statuary work, consists of copper, 89.5 per cent; tin, 5 per cent; zinc, 5 per cent, and lead, 0.5 per cent. The trouble from porosity undoubtedly arises from unskillful handling of the metal while it is being melted. Apparently it is being excessively oxidized and if your mixture contains zinc, this metal will act as a deoxidizer to a certain extent and your percentage of defective castings will be greatly reduced. However, porous castings occasionally will be made from yellow metal containing a high percentage of zinc, particularly when it is not melted properly. Use a covering of charcoal on the copper, adding charcoal when the copper is heated to redness and do not permit the brass to remain in the furnace after it has been melted and is hot enough for pouring. The use of some good deoxidizer also will materially help in keeping down the percentage of defective castings.

Protecting a Steel Shaft

We have an inquiry for a metal to be used on a steel shaft that will wear well on a plastic bronze bearing. The machine is to be used as a dough mixer and the reason for covering the steel shaft is to prevent the dough from coming into contact with the steel, thereby rusting it and contaminating the mass. We know of no bronze or brass covering that will wear well on a plastic bronze bearing and we were wondering if you could give us a mixture suitable for this work.

It seems to us that the best method of protecting the steel shaft would be to tin the parts with which the dough comes into contact. It would be difficult to realize how the dough could come into contact with the bearing and not be contaminated regardless of how the steel would be covered with metals that would not rust.

Dross in Brass Castings

The brass castings which we are manufacturing for hydraulic work, at times contain considerable dross. The metal is melted under a cover of charcoal in fuel oil furnaces. Kindly let us know if some flux can be used by which this dross can be eliminated. Our mixture consists of 80 parts of copper, 14½ parts of tin and 2¼ parts of lead. We are unable to use zinc as the castings are subjected to high pressure. One ounce of 15 per cent phosphor-copper is added to every 100 pounds of metal.

An excellent flux for high tin bronzes is yellow prussiate of potash (ferrocyanide of potassium). It may be added after the copper has been melted and before the tin addition is made, or it may be incorporated with the following materials to form a compound flux: Yellow prussiate of potash, 1 pound; silica sand, ½ pound; soda ash, ½ pound, and bor-

ax, ¼ pound. This mixture should be dropped onto the surface of the molten copper and should be permitted to heat for five minutes to evaporate the water of crystallization from the potash. The copper then should be well stirred and the mixture incorporated. The addition of phosphor-copper may be omitted when the potash is used. One pound of potash will be sufficient to deoxidize 100 pounds of the alloy, but this quantity can be increased if it is considered desirable.

Magnolia Metal

Can you supply us with a formula for magnolia metal or some similar bearing mixture?

The formula of magnolia metal follows: Lead, 80 per cent; antimony, 15 per cent, and tin, 5 per cent. Melt a portion of the lead first and heat it until red. Add the antimony in small pieces and allow it to dissolve, after which the remainder of the lead is added and lastly the tin. Stir the alloy thoroughly.

Brass for Flat Work

We would like to have a brass mixture suitable for casting flat work which has to be machined. The mixture must not be expensive as the fittings are sold at a low price.

A red metal that may be found suitable in this case follows: Copper, 84 per cent; zinc, 10 per cent; tin, 3 per cent, and lead, 3 per cent. Another cheap alloy that may be employed contains the following constituents: Copper, 55 parts by weight; zinc, 10 parts; yellow brass, 30 parts, and lead 5 parts.

For a yellow brass mixture, try the following: Copper, 20 pounds; zinc, 7 pounds, and lead, 1¼ pounds.

Bearing Mixture

We would like to obtain mixtures for the following phosphor bronzes: A very hard metal for high-speed bearings; metal suitable for bearings that will be subjected to 800 to 1,200 revolutions per minute; a mixture for low-speed bearings up to 800 revolutions per minute and a mixture for bevel gears.

For a hard bearing metal use the following mixture: Copper, 86 per cent; tin, 12 per cent, and 15 per cent phosphor-copper, 2 per cent. For low speed bearings use a mixture consisting of copper, 78 per cent; tin, 7 per cent, and lead, 15 per cent. For bevel gears the best bronze to use is what is known as the 10 per cent aluminum bronze. If difficulty is experienced in casting this, however, use an alloy consisting of copper, 88 per cent; aluminum, 10 per cent, and zinc, 2 per cent.

Pressure Alloy

One of our customers complains that the bronze alloy we are furnishing is not satisfactory. The castings are used for pumps and are ¼ inch thick, being subjected to a pressure of 200 pounds. The mixture consists of the following: Copper, 87 per cent; tin, 7 per cent; zinc, 4 per cent, and lead, 2 per cent.

Probably the addition of some good deoxidizer would help materially, and it is our suggestion that such an addition be made. The following alloy might be substituted, as it is particularly well adapted for castings subjected to high water pressure: Copper, 88 per cent; tin, 4 per cent; zinc, 6 per cent, and lead, 2 per cent.

Anti-Friction Alloy

We recently made a cheap anti-friction alloy according to the following formula: Copper, 6 pounds; antimony, 9 pounds; lead, 18 pounds, and zinc, 67 pounds. This was found to be too brittle and the metal loss was very high. Can this mixture be improved, and if not, what would you suggest for this work?

This mixture is one of the poorest that could be made for this purpose. Lead and zinc will not alloy and we would imagine that these two metals would separate while cooling and the bottom of the ingot or casting would consist of lead and antimony with a little copper, while the upper part of the ingot would consist of zinc and copper. We suggest that you discontinue the mixture which you have been using and substitute therefor the following alloy: Lead, 80 pounds; antimony, 15 pounds, and tin, 5 pounds. Melt 40 pounds of the lead, heat red, and gradually add the antimony, stir this thoroughly and then add the remaining 40 pounds of lead. After this addition, the alloy should have cooled from redness to a silvery luster, then remove from the fire, add the tin and ingot.

Wax Molding

We have been experimenting with the so-called lost wax process, but have had some difficulty as a result of the wax adhering to the plaster mold. Can you furnish us a mixture for this wax so that it will not adhere? The wax we have been using consists of paraffine mixed with cornstarch and Venice turpentine. Is the plaster mold coated before the wax is poured into it?

The plaster mold should be soaked in water until saturated and then should be wiped dry before the wax is poured into it. In this condition the wax will not adhere to the plaster.

Anti-Acid Bronze

We would like to have a formula for an anti-acid bronze and also advise us the best flux to use in melting aluminum.

Use the following formula for an anti-acid bronze: Copper, 80 per cent; tin, 6 per cent; phosphor-tin, 4 per cent, and lead, 10 per cent; pour cool. The best flux to use with aluminum is zinc chloride. A small piece, the size of a marble, will be sufficient in ordinary cases to reduce the dross in a No. 35 pot, filled with molten aluminum. The chloride will cause a separation of the mixed molten aluminum and alumina usually found on the surface of the metal in the form of a pasty mass and the alumina will float as a powder, while the metallic aluminum will enter the bath and will become fluid. As this results in considerable saving of aluminum, it always is economical to use zinc chloride when melting this metal.

Nitrogen in Aluminum

We manufacture aluminum hollow ware, and are experiencing some difficulty from pin holes on the surface of these castings. These articles have a thin shell, but are finished with a high polish. We are of the opinion that the molding sand is at fault, as occasionally the surface of the mold will appear to contain some foreign material and when this contacts with the molten aluminum, there is an evolution of gas, which causes small depressions on the surface of the castings. When polished, this depression is found to be larger underneath. We thought possibly that this trouble might be due to the rosin in the sand and to verify this theory, we sprinkled rosin on the surface of the mold, but we find that the puffing action caused by the other foreign substances did not result. Also, we tried the same experiment with other materials used in the foundry, believing that in some way it might have worked into the sand heaps.

Three samples of sand, supposed to be the cause of the difficulties in this instance, were tested, two of the samples consisting of different grades of new sand and the third was heap sand and had previously been used for molding. A sample of the parting also was tried. No traces of foreign matter were found in the new sand. These samples were mixed, tempered and were used as a facing for a mold of a standard aluminum test bar. Another mold

was made and faced with heap sand and on both samples the same parting was used generously. The molds were poured with aluminum of the standard composition consisting of 92 per cent aluminum and 8 per cent copper. The aluminum was poured hotter than the usual temperature, but when the castings were examined, no traces of the difficulty outlined in the inquiry could be discerned.

It is not believed that the sand is responsible for the imperfections in the castings, as it is improbable that any foreign matter could be mixed with the sand and could produce such conditions on the surface of the castings. The parting likewise was not at fault. The defects are due either to faulty melting methods or must be traced to the aluminum before it is melted. If the latter is the case, the trouble will disappear when a new supply of aluminum is obtained or when greater care is exercised in melting the alloy. The latter point cannot be emphasized too strongly, as aluminum oxidizes easily. Also, it absorbs nitrogen and has been found to contain as much as 0.5 per cent of this element. Nitrogen causes porosity and reduces the tensile strength to a marked degree. When strongly heated in contact with any form of carbon, aluminum will combine with this element to form carbide of aluminum. Such a reaction occurs frequently at the bottom of a graphite crucible when aluminum is melted therein and results in the formation of black spots in the castings when the carbide is squeezed to the skin during the solidification of the metal. It is possible, also, that some gas is evolved by the particle of the carbide and that this is the cause of the difficulty in the present instance. The remedy lies in careful melting and if the ingot aluminum is used, the ingots should be cut in half so that they can be inserted into the crucible without the ends protruding. As the metal sinks down in the pot, additional metal should be added until the crucible is full.

It also is advisable to stir the aluminum periodically while melting to dislodge that portion of the metal at the bottom of the pot which has been raised to a higher temperature than that higher up in the crucible. This should be stirred before it can attain a temperature sufficiently high to react with the carbon of the crucible. The carbon, it should be remembered, also is at a high temperature and is in such condition that it can readily combine with the aluminum. When this reaction begins, the aluminum in the immediate vicinity attains a state of incandescence. The reaction may begin in a spot no larger than a pin head and may increase to the size of a pea or even a marble before it is quenched by the comparatively large mass of cool metal above and the lack of additional carbon with which to further combine. When the aluminum is stirred, these heated particles rise to the surface and can be easily observed. Some of the particles of carbide, however, remain in suspension in the molten aluminum and are carried into the castings. Aluminum is one of the most difficult metals to handle and improper melting is the source of most of the casting difficulties encountered in the founding of this metal.

Melting Troubles

We are experiencing difficulty with cast eccentric straps, which contain blow-holes underneath the surface. The castings poured from some pots do not develop these defects and we are at a loss to undersand why these should occur in some castings and not in others. We have tried increasing our percentage of copper, but have not succeeded in overcoming this difficulty.

The use of some good deoxidizer will remedy the trouble which you are experiencing. Phosphor-copper in the proportion of 3 pounds of the 15 per cent alloy might be tried. The reason that you do not always produce porous castings is due to irregularity in melting, or the melting may be done by different melters. It is merely a case of oxidation and it might be well to investigate the manner in which the copper addition is made. The copper should be charged first, being placed in the bottom of the crucible. The scrap is charged on top of the copper, the two of them being melted together, with charcoal as a cover. The zinc and tin are added last. An increase in the amount of ingot copper will not help you overcome your difficulty and in fact, the copper might as well be omitted entirely. The zinc, however, can be slightly increased.

Brass Cylinder Cores

We are making bronze cylinders in weights from 500 to 5,000 pounds, which are to be used for pumps employed in mines containing sulphur. Our mixture consists of copper, 7 parts, and tin, 1 part. We experience great difficulty in removing the cores from the castings. Kindly let us have mixtures for our cores and for a core wash, which will prevent the metal from cutting into the cores.

For the cylinder cores, a mixture consisting of 10 parts of sharp sand and 1 part of flour is usually employed. Another mixture consists of lake sand, 10 parts; silica sand, 10 parts, and to every 15 parts of mixed sand add 1 part of pulverized rosin and ½ part of flour. To prevent the metal from cutting into the core, coat the latter with a good grade of plumbago made into a wash by the addition of molasses water.

Pin Holes in Aluminum

We are casting aluminum balls about 4 inches in diameter. When they are machined, pin holes develop, which do not seem to us to be the result of dirt inclusions. We would like to have information as to how this difficulty may be overcome.

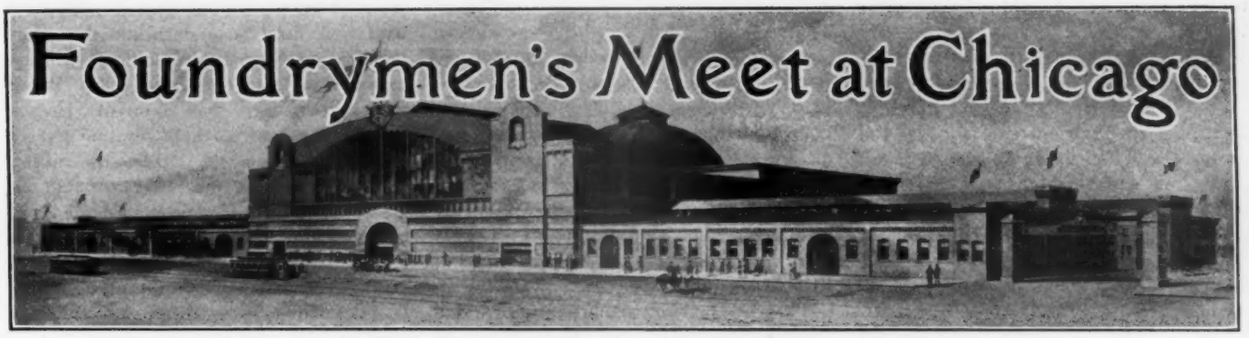
The pin holes are due to gas absorption. After the gas has been absorbed by the metal, a large amount of some element will have to be used that will combine with the gas to effect its removal. Titanium is the most effective agent for the removal of this gas, which generally is conceded to be nitrogen, because the affinity of aluminum for oxygen is so great that it would combine therewith to form oxide of aluminum, or alumina, which is a solid. However, prevention is better than a cure and we would suggest that you use new ingot metal, the No. 12 alloy being best adapted for this work. It should be melted at as low a temperature as possible. Do not overheat any portion of the aluminum while it is being melted and pour the alloy when it is slightly red.

Alloying Lead and Copper

On page 120 of the March issue of THE FOUNDRY *is published an article relating to the alloying of lead with copper. We would like to know what percentage of sulphur should be used in a mixture containing from 50 to 65 per cent of lead and from 35 to 60 per cent of copper.*

We suggest the use of 1 per cent sulphur in a small trial heat, and if this is found to be insufficient, the amount can be increased. So much depends upon the quality of the metal used in making the alloy and the method of handling while in the furnace, that it is more satisfactory in the end for each manufacturer to experiment and to determine what proportion of flux or deoxidizer may be necessary in his own particular case to obtain the best results. In this connection, it may be stated that the use of pure sulphur will not give as clean and satisfactory results in retaining lead in copper alloys as when the sulphur is added in the form of one of its many compounds with other elements.

Foundrymen's Meet at Chicago



Exposition building, in which the foundry exhibit will be held

Preparations for the Windy City Convention

ALTHOUGH six months must elapse before the foundrymen of the country will gather in Chicago for their eighteenth annual convention, active work in preparation for the event is already in full sway. The headquarters and exact dates for the meetings of the affiliated associations have been selected; the building which will house the exhibition has been leased and the local organizations are busy making plans for the comfort and entertainment of the 4,000 visitors who will be on hand when Mayor Harrison makes his address of welcome.

Association Headquarters

Headquarters will be established both by the American Foundrymen's Association and the American Institute of Metals at the Hotel La Salle and the professional sessions of these organizations will be held simultaneously in the two large banquet rooms on the top floor of the hotel building. It is probable that the proceedings will be opened by a joint meeting on Monday, Oct. 13 and that separate sessions will be held on the three following days. The Associated Foundrymen Foremen, who will attend their annual meeting at the same time, have not yet selected headquarters.

Coincident with the conventions of the allied associations, the Foundry & Machine Exhibition Co. will hold its customary exhibit of foundry supplies and equipment. The show this year will extend over a period of eight days opening on Friday, Oct. 10, and closing the following Friday evening. It will probably be closed on Sunday, Oct. 12. The purpose of extending the exhibition period over more than one week is to allow every one plenty of time to cover all of the exhibits, and by opening the show on Friday, the local foundrymen will have ample opportunity to become familiar with the various displays before their guests from out of town arrive.

Large Exhibition Hall

It is expected that the exhibition will be the largest of its kind ever held and in order to have plenty of floor space, the Foundry & Machine Exhibition Co. has leased the International Amphitheater, West Forty-second and Halsted streets, Chicago. This structure is located within 20 minutes ride from the loop district of Chicago and is reached by the South Side elevated railway and by six surface car lines. It is also readily accessible by automobile, via Forty-third street, which connects with all of the north and south boulevards.

The building consists of a central arena, 100 x 200 feet, surrounded by an amphitheater, together with four wings or exhibition courts arranged in the form of a capital H. The building has no basement and is, therefore, specially adapted for exhibiting heavy machinery.

In the west court, which is 526 feet long, there will be a heavy traveling crane and also a railroad track. Plenty of power of all kinds is available and it will be an easy matter to install working displays. It is expected that the exhibition will include all the departments of a modern foundry in actual operation. There will also be an unusual number of machine tool exhibits and many prominent builders will be represented. There is a total of 75,000 square feet of exhibition area on one level in the main building and this can be increased to fully 100,000 square feet by utilizing the upper halls and other available space.

The west annex forms a speedway, 48 feet wide and 525 feet long. The north and south annexes have smooth concrete floors and are each 122 x 160 feet. A steel and concrete passageway connects the main building with 12 brick structures on the west side of Dexter Park avenue, which may be used to more than double the exhibit space. Immediately adjoining the exhibition building is the new Stock Yard Inn, a rambling structure of English architecture. It has 175 sleeping rooms and all the appointments of a modern hotel.

Local Committee

The local committee which will have charge of the entertainment features is now being organized by the foundry interests of Chicago. This committee will include in its membership a large number of those prominent in the foundry business in the west and its chairman will be one of Chicago's most representative citizens. The preliminary work of organization has been undertaken by the Chicago Foundrymen's Club, working in conjunction with the Chicago Foundrymen's Association and the Chicago Association of Commerce. These organizations have appointed a temporary convention arrangements committee, which has held several meetings and has paved the way for the permanent committee. On the temporary committee are E. F. Axner, of the Illinois Steel Co., J. A. Galligan, of Pickands, Brown & Co., James Wood, of the Sheffield Foundry Co., S. T. Johnston, of the S. Obermayer Co., C. B. Carter and H. Cole Estep of THE FOUNDRY (chairman), representing the Chicago Foundrymen's Club; E. L. Cleveland, of the Garden City Foundry Co., representing the Chicago Foundrymen's Association; G. M. Spangler, representing the Chicago Association of Commerce, and C. E. Hoyt, representing

the Foundry & Machine Exhibition Co.

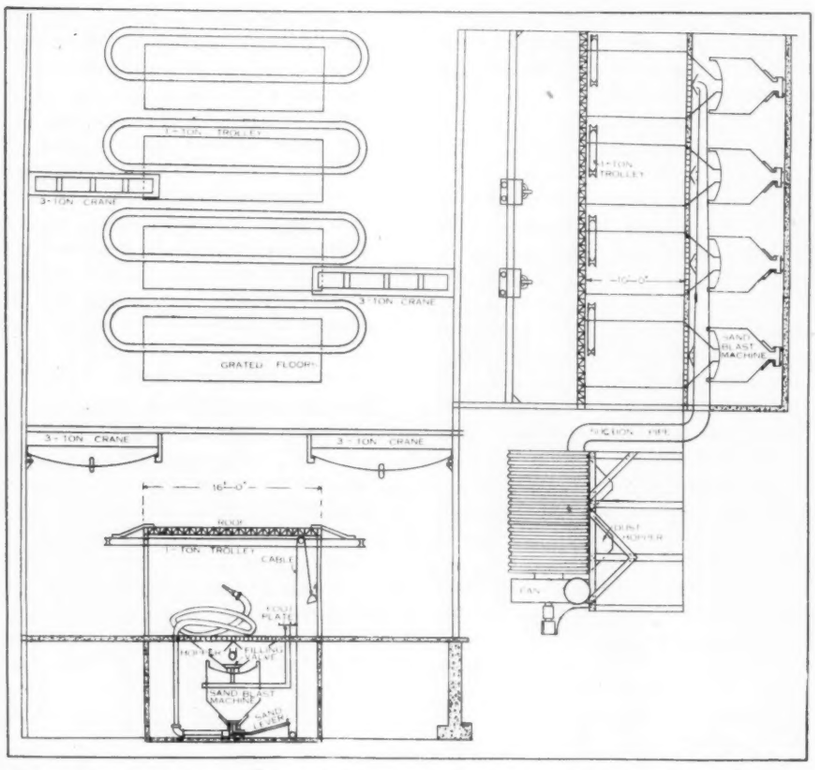
To arouse enthusiasm for the convention, the Chicago Foundrymen's Club will hold a series of get-together meetings throughout the spring and summer. The first of these took place Feb. 8, at which time a turkey dinner was served at the Auditorium hotel. The third meeting will be held April 12 at the Sherman hotel and the others will occur monthly thereafter.

The last foundry convention held in Chicago took place in 1901. At that time Dr. Richard Moldenke was elected to his first term as secretary of the American Foundrymen's Association, a position which he has filled continuously ever since. Western foundrymen are enthusiastic over the selection of Chicago as the scene for the next convention and will make great preparations to insure an occasion that will be long remembered.

The Oscar Schlegel Mfg. Co., New York City, manufactures a line of specialties for pattern shop use, including shellac, shellac thinner, light blonde gum orange shellac, German black pattern extract, German pattern glue and rubber bound glue and shellac brushes. In the circ- are included for their use.

Sand Blast Plant

In view of the excellent results obtained in cleaning castings by the sand blast process, many foundries, particularly those of large output, are making extensive installations of this equipment, which involve the employment of two or more machines. A layout for a plant containing four sand blast machines, made by the Mott Sand Blast Mfg. Co., Chicago, is shown in the accompanying illustration. The same arrangement can be applied to one or more machines and it can be carried out on a much larger scale than herewith shown. The sand blast machines are located in a cemented pit, underneath the cleaning rooms, one pit serving for the four or any number of sand blast machines.



PLAN, END AND SIDE ELEVATIONS OF MOTT SAND BLAST CLEANING INSTALLATION

The four sand blast rooms on the floor above the pit are separate and are constructed of No. 12 gage steel sheets. Each room is provided with double doors in the front and rear, and extending through and around each room is a one-ton I-beam trolley, from which the castings are suspended while they are being sand-blasted. Two three-ton traveling cranes, operating the length of the cleaning department, deliver the castings to the I-beam trolleys after cleaning. The castings can be sand-blasted either while they are suspended from the trolley, or they can be placed on a bench, if desired. The floor of each room is grated with steel bars and directly underneath the grating and connected therewith is a container, into which the sand falls. When all of the sand has been discharged from the machine, the operator presses a foot lever, which opens the filling valve, permitting the sand to fall by gravity from the container into the sand blast machine. This arrangement eliminates the use of sand-handling and conveying equipment and in addition, the operator always is in control of the sand supply.

The hose and its control is the only equipment in the sand blast room. The compressed air and the sand levers are operated by cables leading over pulleys in the sand blast rooms. To the ends of the cables handles are attached, which are at a convenient height for their easy manipulation by the casting cleaner. Directly underneath the grated floor and in the sand container of each machine is a hood connected with an exhaust pipe leading to the dust arrester. The dust is exhausted downwardly through the grating of the floor of each room and is delivered to the arrester, from which it is discharged through two chutes.

Annealing Admiralty Gun Metal

"The Heat Treatment of Admiralty Gun Metal" was the subject of a joint paper by H. S. and J. S. C. Primrose, which was presented at the annual meeting of the Institute of Metals, held at London, March 11 and 12. The research was undertaken to ascertain a simple and reliable method of improving admiralty gun metal so as to obtain the highest possible tensile strength without reducing the percentage of elongation and at the same time imparting to this metal a greater soundness and homogeneity of structure. This alloy consists of copper, 88 per cent; tin, 10 per cent, and not more than 2 per cent of zinc, a variation of 1 per cent of any of the component metals being the maximum allowance. The proper composition, the authors stated, is readily obtained in practice, but even when the analysis closely agrees with the specification, it is sometimes difficult to produce castings which will fulfill the requisite physical tests. Many foundrymen have experienced considerable trouble in making sound castings with this alloy, which will withstand high water pressures.

Although blow-holes are the commonest of unsoundness in gun metal, these may be entirely absent, yet the castings may not be completely satisfactory when submitted to the physical tests and hydraulic pressure, owing to the imperfect arrangement of the con-

stituents. The metal may fail in the hydraulic test as a result of the water sweating through the microscopic pores. When gun metal is cast and slowly cooled, the first portions to solidify consist of primary crystallites of one constituent, which is copper containing all the zinc and only a small quantity of tin in solution in it. As the crystals continue growing and the temperature falls, an increased amount of tin is held in solution and at the moment of solidification, the interspaces are filled with a constituent which is copper containing a still higher percentage of tin in solution.

In making the test, 1-inch round bars, 10 inches long, were employed, which were cast from gun metal at a temperature just below 1,100 degrees Cent. Both dry sand molds and chills were used. The cooling was moderately slow for the dry sand castings, comparatively quick for chills alone, and very slow when the metal was cast in chills placed in close proximity to and in connection with a large body of metal cast at the same time.

To ascertain the affect of heat treatment upon the bars, these were gradually heated to the required temperature in an electric resistance furnace, thereby minimizing the oxidation of the metal. No appreciable loss of zinc was noted even at high temperatures. The experiments showed that the annealing of the metal for 30 minutes very considerably increased its strength and elongation, the maximum result being obtained after annealing at 700 degrees Cent.

Method of Annealing

To anneal gun metal castings in the foundry, some type of muffle furnace, of a size large enough to hold a number of the castings to be treated should be installed. To maintain a uniform temperature during the annealing and also to regulate the heat in cooling, the furnace should be either gas or oil-fired. The temperature must be controlled by a pyrometer and the workman in charge of the operation should be under supervision to insure that he does not exceed either the temperature or time limits found to be needed for each class of castings under treatment.

One great advantage derived from the annealing of gun metal lies in making the metal capable of complying with the most stringent specifications as regards tensile strength and elongation. However, metal that may be defective, due to the presence of gas or blow-holes, is not materially improved by this heat treatment. Slight defects, such as sweating, etc., is completely removed by proper annealing. Castings, otherwise sound, frequently fail when they are subjected to the hydraulic test and the metal is condemned as bad. However, this strange characteristic is due to the wrong arrangement of the metal constituents, which can be remedied by annealing as recommended.

Corrosion Resistant

The tests of bars cut from large castings prove the value of annealing this cast material. Prior to the heat treatment, the elongation of these bars was only 5 per cent, but after annealing at 700 degrees Cent., for 30 minutes, the elongation was increased to 25 per cent and the tensile strength, approximately 30 per cent. Brinell tests also were made and it was found that the hardening effect of chilling the metal was even greater than that of quenching and this difference is not completely removed by annealing. It also was found that annealed gun metal would resist corrosion to a greater extent than metal not so treated.

In summarizing the results obtained, the authors state that no improvement in the properties of gun metal is obtained by quenching, which lowers the strength of the material. However, annealing the metal for 30 minutes very considerably increases its strength and elongation, the maximum result being obtained after annealing at 700 degrees Cent. The homogeneity and other physical properties of the metal are correspondingly improved, particularly the capability of the castings to withstand hydraulic pressure.

Air Compressor for Small Plants

The diversity of profitable applications for compressed air in small volume not only in small plants, but frequently in large shops, has made the installation of small air compressor units an economical necessity. In addition to the item of low first cost of installation, the use of compressed air by the small plant has made it necessary that the air compressor be economical in the use of power and maintenance and as nearly automatic in operation as possible so that the cost of attendance may not prove excessive.

To meet this demand, a line of small vertical air compressors recently has been placed on the market by the Ingersoll-Rand Co., New York City. These compressors are lubricated automatically, are equipped with simple plate and ring valves, are of the enclosed type of dust-proof construction and are exceedingly compact. The machines are furnished in a number of sizes for belting to line shaft or as a complete electric unit in capacities from 4 to 23 cubic feet and pressures up to 150 pounds. In the accompanying illustration is shown a portable air-cooled electric unit. The compressor and motor are mounted on a three-wheel truck and the compressor can be taken to any part of the shop where the work is to be done.

PORTABLE, MOTOR-DRIVEN AIR COMPRESSOR

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade.

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Trade Outlook

PERIODS of prosperity always foster new enterprises with resulting surplus capacity, over-production and depression. We are now in the throes of an era of foundry expansion. Every manufacturer unable to obtain prompt deliveries of castings is contemplating the erection of a foundry. Measured by the number of new plants proposed, the malleable trade must be unusually active. Crucible steel foundries rank next, with converter, open-hearth, brass and gray iron shops following in the order named. Prompt deliveries of castings are difficult to obtain and this is more pronounced in the lines affected by the heavy railroad buying. Producing capacity, however, is being rapidly increased, although the added melting facilities will not figure in the output until later in the year. The softening of the pig iron market in all centers reflects too large a production of merchant grades rather than a reduction of the foundry melt. In this connection it is interesting to note that foundrymen generally are anticipating shipments on their contracts with the blast furnaces and foundry yards are practically bare of stocks. In the leading producing centers, foundry grades are quoted as follows: No. 2, Pittsburgh, $17.40; Chicago, local, $17.50; Cleveland, $17.25; Cincinnati, southern Ohio, $17.20; Philadelphia, $17.50; Buffalo, $16.50, and Birmingham, $15. Malleable, Pittsburgh, $17.40, and Chicago, $17.50. Basic, Pittsburgh, $17, and Philadelphia, $17.50.

We are now producing pig iron at the rate of 33,000,000 tons annually, as compared with 23,000,000 tons in 1911. The output in January and February, this year, was 5,368,259 tons, as compared with approximately 4,150,000 tons during the same months last year. Germany, our nearest rival, is now producing iron at the rate of 20,000,000 tons yearly.

The Sash Weight Bug

WERE you ever stung by the sash weight bug? This insect thrives and multiplies in gray iron shops and becomes particularly active at the end of the heat when a considerable amount of left-over iron has to be pigged. The sting then partakes the form of an aroused commercial instinct which sooner or later results in the installation of more or less crude sash weight equipment. Little does the foundryman realize the trouble he is storing up for himself as he invariably is blinded by the desire to cast, into some commercial form, the iron that otherwise is poured into the pig bed. Sash weight manufacture is a highly specialized branch of the foundry industry, which represents a large investment. The sale of the product is more involved than would generally be presumed, as the avenues of outlet are controlled largely by jobbers who demand a complete range of sizes and weights and a large stock which must be carried by the foundryman, to meet requirements promptly. Shops that attempt to utilize left-over iron in this way, at best can only hope to serve a local market and this in an inadequate manner. The competition of the sash weight foundries is another factor to be considered and it frequently will be found that the selling price represents only a small spread from the cost of the metal, to cover the molding labor. Permanent molds have been

used for many years by several foundrymen specializing in sash weight manufacture. These are both water-cooled and solid, the life of both being counted in thousands of castings. The molding machine also is employed and the necessary pattern plate equipment for all sizes of weights represents a tremendous outlay. While the product is classed among rough castings, nevertheless the weight of the section must be fairly accurate and the eye must be sufficiently smooth to prevent cutting the rope or chain. When permanent molds are employed, the cost of labor per ton of output is exceedingly low, yet this is closely approached by molding machine operations. In several shops an operator and helper produce from 75 to 100 molds per day, containing from two to eight sash weights each, depending upon their size. In addition, these men pour off their floor and to aid in handling the large amount of metal necessary, a bull ladle is employed. The molds are stacked with the sprue of each extending away from the edge of the flask above a sufficient distance only to admit the stream of metal. A common sprue for these molds also could be employed, without resulting in a variation in the weight of the bottom and top castings, which is the objection frequently raised against stack molding. Almost any form of iron-bearing scrap can be used, provided, of course, that the melting operations are carried on in a way that will insure the desired results. There is little economy in using, in loose form, such fine scrap as sheet and tin plate clippings, drillings, borings, etc. The metal losses, due to oxidation, will be high unless the metal chips are boxed or charged in pipes and the clippings should be compressed into small bundles. The coke consumption, necessarily will be high, and the limestone or other flux should be increased over the amount employed for ordinary mixtures.

For the benefit of its readers and advertisers, THE FOUNDRY has established an office at 611 Bulletin building, Philadelphia, in charge of L. E. Ives, eastern advertising manager. The Chicago office has been removed from 1328 Monadnock block to more commodious quarters at 1521 Lytton building. In addition, THE FOUNDRY maintains the following offices: New York, 1115 West Street building; Pittsburgh, 2148 Oliver building; Cincinnati, 503 Mercantile Library building, and Birmingham, Eng., Prince's Chambers.

The Future Foundryman?

THE establishment of a course of training for young men who wish to make foundry work their vocation, is now being considered by the directors of the Pratt Institute, Brooklyn, N. Y. The full time of the student would be required, from October to June, and the work would involve a wide variety of practice in the Pratt Institute foundry, accompanied by talks by the foundry instructor on practical methods of handling different jobs. The students also would be given a moderate amount of instruction in applied science related to foundry practice, as well as patternmaking and machine work, sufficient to acquaint them with the relation of these trades to the manufacture of castings. The purpose of the course would be to attract young men of character and intelligence and to give them nine months' practical training which, coupled with practical experience in the business, should develop molders possessing both skill and exceptional comprehension of the art. The incentive for the student to invest time and money in such a course would be more rapid advancement and a greater likelihood of promotion, in due time, to foremanships and other positions of responsibility. Before establishing this course, the director of Pratt Institute solicits answers to the following questions:

Does the foundry business need young men of the type mentioned?

Could young men of this kind readily find openings in the foundry business?

Would these young men probably advance more rapidly to warrant the time and money they would invest in their training?

Do you think that the training would materially increase the likelihood of the promotion of these young men to foremanships after ample experience?

Do you consider this plan practicable?

If you are interested in raising the standard of foundry mechanics, write the Pratt Institute and urge the establishment of this course. The casting industry is suffering from a dearth of schools of this kind, from a lack of interest in the training of apprentices and from a superlative degree of satisfaction in present conditions without concern for the future.

What will the new administration do to the tariff on aluminum? The ways and means committee is promised an interesting session with a delegation of foundrymen specializing in the casting of this white metal, who have not received shipments on their contracts for many months. Incidentally, there are many reports of the establishment of new aluminum reducing plants, independents of course, but there is a suspicion that some of these are not as *independent* as they may seem.

Can You Beat It?

WE ARE now on the charging floor of Bill Slack's foundry, which is located in a badly swollen community in the middle west. Bill, by the way, was a cattle buyer out on the plains until the beef barons insisted upon getting not only the cream, but the skimmed milk, too. We'll return to the foundry. The blast is on and the cupola, which was artistically carved out of an old boiler, is roaring and groaning under the weight of a 3,000-pound heat. Two men are charging—Miquel and Angelo. The former is engaged in fastening a rope around a broken pig which Angelo will carefully hoist to a staging on a level with the charging floor. You wonder why? The reason is that the platform is six feet below the charging door. Ask Bill and he'll tell you he thought it should be that way. We are now on our inspection tour of the shop. In the foreground, whatever section of the foundry that may be, is a one-ton side-blow converter, recently installed. The mouth of the vessel is turned at a rakish angle toward the wooden roof and side of the building. The hood is tin plate, carefully soldered. No, Bill has not blown a heat yet, but the chances are that when he does the metal will be chilled in the converter as a result of the strenuous activities of the fire laddies. Can you beat it?

German Centrifugal Sand Mixer

By H. Thieme

A motor-driven, centrifugal sand mixer, used extensively in German foundries, is shown in the accompanying illustrations. The frame of the machine, as illustrated in Fig. 1, consists of four pillars bolted to an iron base. The pillars support the feed hopper and the conical casing. The latter prevents scattering the sand and precipitates it around the base of the machine, as illustrated in Fig. 2. The pillars likewise support the motor which is completely enclosed and is protected from the sand. Keyed to the upper end of the motor shaft is a horizontal disc which is provided with three rows of staggered pins. Current from an electric lighting circuit is sufficient to operate the machine. The disc with the pins is rotated at a high speed and the mixing of the sand is accomplished by passing it between the rotating pins. The sand is thrown against the conical casing by centrifugal force and falls to the floor. All lumps in the sand are broken up and, in addition, particles of iron are separated from the sand and collect on top of the disc. The sand can be used without further screening. A motor of 2 horsepower capacity will operate the machine at 960 revolutions per minute. The machine weighs approximately 550 pounds and is about 4 feet high and 3 feet in diameter.

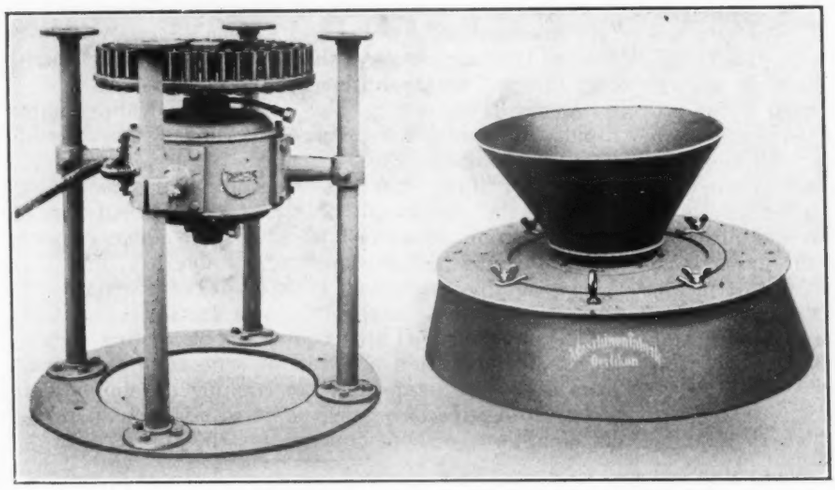

FIG. 1—PARTS OF A GERMAN CENTRIFUGAL SAND MIXER

Philadelphia Foundrymen Meet

Following the regular business meeting of the Philadelphia Foundrymen's Association, at the Hotel Walton, Philadelphia, on Wednesday evening, March 5, A. G. Warren, mechanical engineer, associated with the J. W. Paxson Co., Philadelphia, gave a most interesting talk on sand blast equipment for foundries and other purposes. With the assistance of I. F. Kremer, a large number of lantern slides were presented, showing many installations in this section of the country. Some views of installations made 10 to 15 years ago brought out forcibly the great advancement that has been made in the development of sand blast equipment since that time, resulting in the present high efficiency of such machines.

After a brief discussion of some points brought out by Mr. Warren, a number of views were given showing various new foundries in the east that are noted particularly for complete and modern equipment or for special construction features.

Stereopticon An Aid to Selling

The J. W. Paxson Co., Philadelphia, manufacturer of foundry equipment and supplies, has adopted a novel method of displaying its products at the works of its customers. This is accomplished by an electric stereopticon, wich may be operated by direct or alternating current and can be attached to an electric lamp socket. Enlarged views are thrown on a screen, showing the equipment in elevation and in cross-section. The salesmen of this company are provided with stereopticons, slides and price lists, thereby enabling them to not only quote, but also to show the equipment in enlarged size to the best advantage. Slides have been made of all the supplies and equipment used in iron, steel and brass foundries, as well as the company's sand plants in Rhode Island, New York, New Jersey, Pennsylvania and Delaware. In addition, views have been made of the steam barges and tug boats operated by this company by which the sand is delivered to various points along the Atlantic coast and by river and canal to points in the east. New slides are being continually added and this new method of exhibiting equipment has already been received favorably by foundrymen.

The office and laboratories of the Detroit Testing Laboratory, Detroit, have been removed from 1111 Union Trust building to 674 Woodward avenue, where larger quarters have been obtained.

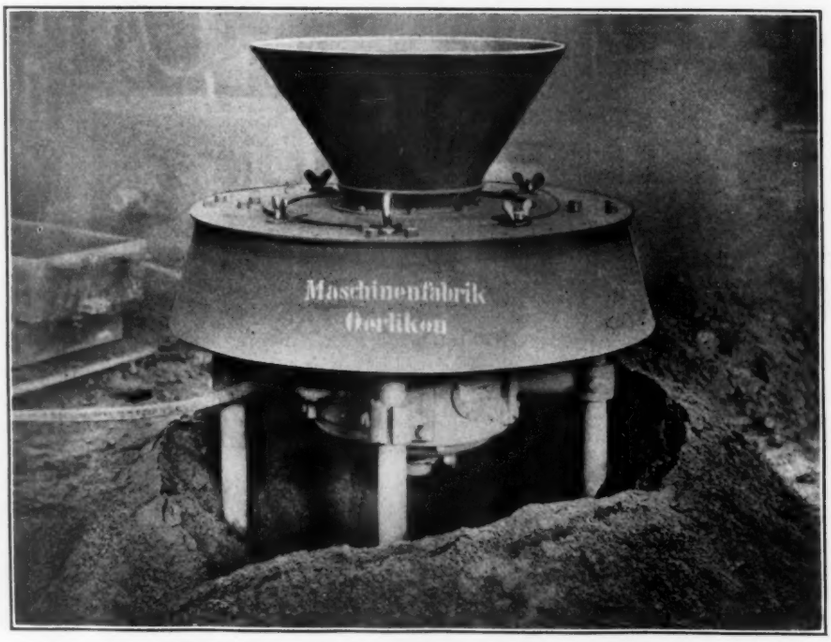

FIG. 2—THE CENTRIFUGAL SAND MIXER ASSEMBLED AND IN OPERATION IN A GERMAN FOUNDRY

THE MEN IN THE FOUNDRY TRADE

Where They Are and What They Are Doing

HENRY J. TURNER, Buffalo, has been elected vice president of the Chadwick Brass Co., Ltd., Hamilton, Ont.

JOSEPH S. STRINGHAM has been appointed general manager of the plant of the Monarch Steel Castings Co., Detroit.

E. L. HENDERSON, Carrollton, O., has purchased a controlling interest in the Means Engineering & Foundry Co., Toronto, O.

C. H. FRANK has been elected secretary and treasurer of the J. D. Smith Foundry Supply Co., Cleveland, succeeding E. S. Gaylord, resigned.

KESTER BARR, formerly affiliated with Manning, Maxwell & Moore, Inc., New York City, has resigned and has been appointed manager of the West Toronto, Ont., plant of the Lumen Bearing Co., Buffalo, succeeding Fred Ganderton.

GEORGE F. COMSTOCK has resigned as metallurgist of the Park Works of the Crucible Steel Co., Pittsburgh, and has been placed in charge of the physical testing laboratory of the Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

A. B. COOPER JR. has established offices in the Drexel building, Philadelphia, as manufacturers' agent for iron and steel castings. He was formerly superintendent of the Brylgon Steel Casting Co., New Castle, Del.

CHARLES BRADY, Cleveland, has been appointed general manager of the Aluminum Castings Co.'s plant at Manitowoc, Wis. Mr. Brady succeeds Conrad Werra, who recently resigned to organize the Waukesha Aluminum Co.

ARTHUR G. TRIMBLE has been appointed traffic manager for the Whitney-Kemmerer Co., dealer in pig iron, coal and coke, Oliver building, Pittsburgh. Mr. Trimble was formerly with the United States Cast Iron Pipe & Foundry Co.

JOHN H. BURNS JR., who for a number of years had charge of the purchasing department of Dodge Bros., Detroit, is now associated with I. M. Jacobson & Sons, smelters and dealers in metals and alloys, 408 Ford building, Detroit. This company recently has completed a new smelting plant at 70 Catherine street.

J. E. MCCAULEY, sales agent of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., has been appointed assistant general manager of the works of that company. Mr. McCauley has been with the company about four years. Prior to that time he was employed by the Baldwin Locomotive Works, the Standard Steel Works Co., and the Solid Steel Casting Co.

HERMAN BACHARACH, mechanical engineer, has removed from 722 Lewis block, Pittsburgh, into larger quarters in the Hartje building. Mr. Bacharach has increased his line of industrial instruments and now is handling, in addition to recording steam and gas apparatus, smoke and dust recorders, specific gravity meters for gas and liquids, carbon dioxide recorders, engine indicators, etc.

E. S. CARMAN has been appointed chief engineer of the molding machine department of the Osborn Mfg. Co., Cleveland, in charge of design and construction. Mr. Carman has had a wide experience as an engineer and has devoted several years to the design and development of molding machines. After completing his engineering training, Mr. Carman spent some time in practical machine shop work, which was followed by 10 years of successful engineering practice.

B. H. REDDY, who resigned some time ago as chief engineer of the W. W. Sly Mfg. Co., has engaged in business as sales representative and consulting engineer for the design and equipment of foundries and manufacturing plants and has established an office at 4317 Windsor avenue, Cleveland. Mr. Reddy has had a wide shop experience, extending over a period of about 20 years, and has served in turn as master mechanic, superintendent, chief draftsman, superintendent of construction and chief engineer. Mr. Reddy is the designer of a number of large plate mills.

A. C. OVERHOLT, resident manager, and W. R. Hill, assistant resident manager, at Scottdale, Pa., of the United States Cast Iron Pipe & Foundry Co., retired March 1. A few days before their resignations took effect, Mr. Overholt was presented a loving cup and Mr. Hill a watch by their business associates. Mr. Overholt is vice president of the First National Bank of Scottdale, a director of the Scottdale Savings & Trust Co., and is vice president of the Lincoln Coal & Coke Co. Mr. Hill had been associated with the United States Cast Iron Pipe & Foundry Co. a number of years. He was appointed assistant resident manager upon the death of his father, J. D. Hill, who was closely associated with Mr. Overholt in various business enterprises.

NEW TRADE PUBLICATIONS

WOOD BLOCK FLOORING.—In a 24-page catalog, issued by the Kettle River Co., Minneapolis, the merits of creosoted wood block flooring for use in foundries, machine shops, warehouses and industrial plants generally are pointed out and numerous views are included of these floors in various shops.

LUBRICATION OF PNEUMATIC TOOLS.—An eight-page bulletin, issued by the Chicago Pneumatic Tool Co., Chicago, is devoted to the lubrication of pneumatic tools and contains many valuable suggestions covering the care of these tools to prolong their life at a minimum cost for repairs. Automatic oiling devices are described and a grease machine also is shown.

PATTERN SHOP MACHINERY. — A handsomely-illustrated, 64-page catalog devoted exclusively to pattern shop machinery and equipment has been issued by the American Wood Working Machinery Co., Rochester, N. Y. The operation of wood working machines by electric motors is recommended and valuable suggestions are made covering the features of both individual and group drive. These and other hints on this subject will prove of value to every pattern shop operator. A notable feature of this catalog is the numerous safety devices with which the various tools are equipped. The machines described include speed lathes, band scroll saws, ball bearing band saws, universal saw benches, surfacers, hand jointers, buzz planers, four-sided molder, shapers, sand papering machines, knife grinders, emery grinders, grinders and buffers, grindstone frame, etc. Among the small tools and equipment shown are tool holders, turning gouges, drill chucks, hand and foot mitering machines, foot power mortisers, post borer, post sander, saw filing and setting machines, band saw brazers, pattern-makers' benches, glue heaters, etc.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The plant of the Christy Steel Co., Akron, O., recently destroyed by fire, will not be rebuilt.

The Central Radiator Co., Lansdale, Pa., has increased the wages of its molders 10 per cent. The shops recently have been extended by the completion of a large addition.

The Southwest Foundries Co., San Diego, Cal., has been incorporated with a capital stock of $10,000 by R. H. Baker, Fred Baker and J. D. Johnson.

The Firestone Steel Casting Co., Thirty-first street and Kedzie avenue, Chicago, has installed a one-ton converter for the manufacture of steel for casting purposes.

The plant of the Bellingham Foundry Co., Bellingham, Wash., has been sold to R. E. Runkel. The plant has been remodeled and business will be continued under the name of the Bellingham Iron & Steel Foundry.

The Oliver Chilled Plow Co., South Bend, Ind., recently has completed the installation of a two-tone side-blow converter, which was furnished by the Whiting Foundry Equipment Co., Harvey, Ill.

D. J. Renaud & Son, brass and iron founders, Carthage, N. Y., have completed a new plant, which includes a gray iron foundry, 48 x 70 feet; brass foundry, 30 feet square, and a machine shop, 30 x 50 feet.

The new casting plant built by the Dalton Foundry, Warsaw, Ind., has been placed in operation. The main building is 80 x 150 feet; core room, 32 x 50 feet; machine shop and shipping department, 50 x 125 feet. The melting equipment consists of two cupolas.

The Kells Foundry & Machine Co., East Gary, Ind., has been dissolved and a new concern, with a capital stock of $40,000, has been organized under the firm name of the Continental Foundry & Machine Co. Charles Pekat is president.

Due to cheaper power and better shipping facilities, the Record Foundry & Machine Co. has decided to dispose of its Montreal plant, which is now practically closed and will concentrate manufacture at Moncton. The sales agency at Montreal will be continued.

Electric furnaces and equipment will be manufactured by the Chicago Electric Castings Co., Chicago, which has been incorporated with a capital stock of $11,000. Wilton Bently, of the Bently-Snyder Co.; Edward C. Higgins and Matthew Finn are the incorporattors.

The William Tod Co., Youngstown, O., manufacturer of rolling mills, engines, etc., has installed two air furnaces, which will greatly increase the melting capacity of the plant. The foundry is being equipped to produce sand and chilled rolls, in addition to the line of engine and general machinery castings now made.

For the purpose of manufacturing automobile engine cylinders, the Peru Foundry & Machine Co., Peru, Ind., has been organized by I. H. Barbee, formerly chief engineer, R. E. Carter, formerly efficiency engineer, and C. E. McCampbell, formerly foundry superintendent of the Chain Belt Co., Milwaukee. A plant at Peru, at one time owned by the Otis Elevator Co., has been acquired and operations will be started at once. In the new firm C. E. McCampbell is the president, R. E. Carter, vice president and I. H. Barbee, secretary-treasurer.

New Construction

The Haskell & Barker Car Co., Michigan City, Ind., is building extensive additions to its foundry.

A foundry to employ 100 men will be erected at Medicine Hat, Alta., Can., by the Medicine Hat Radiator Co. L. Carey Wright, Sauk Centre, Minn., is president of the company.

Deere & Co., Moline, Ill., manufacturers of agricultural implements, will erect two foundry buildings, two stories, 600 feet long, on property recently purchased at East Moline.

The Union Foundry Co., Fitchburg, Mass., is building a large addition to its main foundry. Contracts for the new machinery necessary have been placed and the building will be completed early in April.

The Union Foundry Co., Fitchburg, Mass., is erecting a large addition to its plant to provide facilities for doubling the present output. Contracts for the buildings and the new equipment already have been placed.

Plans have been completed for a two-story foundry, 60x300 feet, for the Westinghouse Air Brake Co., Wilmerding, Pa. The equipment will include two five-ton electric traveling cranes. The McClintic-Marshall Construction Co. will erect the building.

The Moline Scale Factory, East Moline, Ill., will extend its foundry by the erection of an addition, 80 x 60 feet, and a new core room and cleaning department is to be added, 40 x 130 feet.

The Saco-Lowell Machine Shop, Lowell, Mass., is having plans prepared for a cupola house, 47x73 feet, and a one-story foundry, 50x220 feet. The Hooper-Faulkner Engineering Co., New York City, is the consulting engineer.

A building of one and two stories, 110x120 feet, is being erected by D. J. Hauptman for the Paragon Foundry Co., Grand and Forty-sixth avenues, Chicago. The building will cost $25,000 and is to be completed by May 1.

T. McAvity & Sons, St. John, N. B., manufacturers of gray iron and brass castings, contemplate making extensive additions to their plant, which will include a malleable iron foundry, 100 x 500 feet; brass foundry, 100 x 250 feet, and a pipe foundry, 100 x 300 feet.

The Pioneer Tractor Co., Ltd., will erect a plant at Calgary, Alta., Can., which will consist of a machine shop, 100x600 feet, and a foundry, 80 x 100 feet. Orders for the equipment are now being placed by D. M. Robinson, purchasing agent of the Pioneer Tractor Mfg. Co., Winona, Minn.

The National Cash Register Co., Dayton, O., will build a large plant at Toronto, Can., on a sight of eight acres, which will be served by the Canadian Pacific and Canadian Northern railways. The plant will consist of three buildings, including a foundry, 60x120 feet; machine shop, 300x60 feet, two stories high, and the main building, 310x60 feet, three stories high. The latter structure will contain the offices, assembling and stock departments, etc. Eventually a wood-working plant is to be erected. All of the buildings will be of uniform construction. The frame work will be steel, the foundations concrete and laminated wood floors will be laid. The foundry will be eqipped with two batteries of coke furnaces, 10 furnaces to a battery, and to recover the metal from skimmings, foundry ashes, etc., a washer will be installed. A large number of molding machines also will be purchased. The building will be divided into spans of 25, 10 and 25 feet, the 10-foot span serving as an aisle, providing a working area 25 feet wide on either side. The buildings are so arranged that the stock can be routed in a direct line to the point of outlet. The large window area of these buildings will be a noteworthy feature, as the walls will contain approximately 85 per cent of window space. All of the structures will be so built that they can be added to without inconvenience and the partitions will be portable and will be built of steel and glass. The basement of the main building will contain wash rooms, lockers, showers, lunch and recreation rooms and the officers' club. The services of a landscape gardener will be employed to lay out the grounds, which will include an athletic field for the company's employes. H. Daly is superintendent of the Canadian factory.

Among the Brass Founders

The Bateman Mfg. Co., Grenloch, N. J., will erect a new brass foundry.

Owing to the death of J. A. Bradford, the plant of the Charlotte Brass Works, Charlotte, N. C., will be sold.

The Aluminum Goods Mfg. Co., Manitowoc, Wis., has completed plans for the erection of an addition, 50 x 200 feet.

The new foundry which will be erected at Flint, Mich., by the United States Brass & Iron Co. will be 75 x 200 feet.

The Chapman Specialty Co., Canton, O., has been incorporated with $10,000 capital to engage in the manufacture of radiator valves. S. DeWitt Chapman and E. H. Lamiell are among the incorporators.

The National Brass Mfg. Co., London, Ont., has been organized with a capital of $40,000 to engage in the manufacture of plumbers' supplies. The directors include John F. Grant, Charles H. Ivey and John O'D. Dromgole.

Leitelt Bros., 6338 Madison avenue, Chicago, have been incorporated with $10,000 capital to engage in the operation of a brass foundry. Edward and Charles F. Leitelt and Matthew J. Hevenor are among the incorporators.

The Edwards & Smith Co., Fifteenth and Washington streets, Philadelphia, has removed its brass, bronze and aluminum shop to Easton, Pa., where the buildings formerly occupied by the Easton Brass Co. have been obtained. A large amount of new equipment will be purchased.

A building, 40 x 100 feet, to provide additional molding floor area, will be erected by the Falcon Bronze Co., Youngstown, O. G. A. Doeright is president and general manager. The contract for the structural steel has been placed with the Hunter Construction Co., and the work of erecting the building will begin April 1.